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Extension Agricultural Agents' Perceptions of Sustainable Agriculture in the Southern Region of the United States.

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EXTENSION AGRICULTURAL AGENTS' PERCEPTIONS
OF SUSTAINABLE AGRICULTURE IN THE
SOUTHERN REGION OF THE UNITED STATES

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The School of Vocational Education

by

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ABSTRACT

The purpose of this study was to describe extension agricultural agents' perceptions of sustainable agriculture in the Southern Region of the United States. The population included Cooperative Extension county/parish agents with major responsibility in agriculture working in the 13 states of the Southern Region of the United States. These individuals were either employed by the thirteen institutions established by the Morrill Act of 1862 (the 1862 Cooperative Extension Services) or by eleven institutions established by the Second Morrill Act of 1890 (the 1890 Cooperative Extension Services).

The study investigated agents' perceptions of sustainable agriculture concepts, and agents' perceptions of factors and their potential impacts on the sustainability of production agriculture. The study also investigated agents' perceptions of trends and their relationship to the future of sustainable agriculture, their perceptions of the capabilities of the Cooperative Extension Service in sustainable agriculture, and their perceived competencies in sustainable agriculture.

Differences in the above perceptions were investigated by the following variables: age, farm clientele with whom major amount of time was spent, technical area where major amount of time was spent, undergraduate major, graduate major, farm background, and type of institution of employment. Data collection was accomplished by means of a mailed questionnaire with a 95% return rate.

Respondents perceived that the Cooperative Extension Service provides the major leadership in areas of sustainable agriculture technology in their county/parish and that more time and funding should be allocated for training in the areas of sustainable agriculture.

Respondents perceived themselves to be slightly or moderately competent in sustainable agriculture. The lowest mean rating was for the use of computer software in sustainable agriculture while the highest mean rating was for minimum tillage production systems.

Respondents with farm background perceived themselves to be more competent in sustainable agriculture than agents with no farm background. Respondents working in rural plant science perceived themselves to be more competent in sustainable agriculture than agents working in rural animal science or urban plant science. No statistically significant differences were found at the .05 level in perceptions of competencies between the agents employed by the 1862 Cooperative Extension Services and the 1890 Cooperative Extension Services.

CHAPTER 1: INTRODUCTION

Since its inception in the early twentieth century, the Cooperative Extension Service has been a national catalyst for change. Major innovations and improvements in agricultural production methods in this country have been brought about primarily by the expansion and development of research and extension through the land grant university system. Since the 1930s and the advent of rural electrification, many innovations have had an impact on agricultural production: new planting and harvesting machinery and methods; the development of synthetic fertilizers and an array of various pesticides; new developments and improvements in the farm tractor; and higher yielding, insect and disease resistant crop varieties. These have all contributed to an improved and diversified food production system, as well as a greater quantity and availability of food products for the population, with commodities swelling, in some cases, to vast surpluses.

The concept of agricultural food production as an entity has changed during this period of emerging growth and prosperity for the country. Agricultural food production has grown from the pre-World War II concept of a single family farm, producing food and fiber for the livelihood of the immediate family, to the multi-level farm conglomerate of today that produces crops on thousands of acres and markets the products nationally and internationally.

A wide range of federal agricultural policies, which include farm commodity support programs, have influenced agricultural production practices, promoting maximum yields in cropping systems and the increased use of marginal lands. These increased yields generally have been accomplished with the continuing use of heavy inputs of fertilizers, accompanied by diverse pesticide applications. As a whole, these policies work against environmentally favorable

production systems (National Research Council, 1989). Associated outcomes have had a far-reaching effect on the environment in this hemisphere, and on a global scale as well, creating ever-increasing chemical residues in ground water resources and threatening the quality of the drinking water for our population (Williams, Holden, Parsons, & Lorber, 1988).

The decades from the 60's to the 90's have seen the demise of the farmer, in the eyes of some members of the public, from a place of prominence as a food provider to that of an environmental assailant. Not only does the public want food and fiber, but also an accounting as to the production methods and the environmental consequences of these production methods. The "Environmental Movement," in addition to creating an awareness and sensitivity towards a number of traditional agricultural production practices perceived by many as environmentally unfriendly, has also resulted in the development of regulations that place constraints on agricultural production systems. These constraints have the potential to threaten the survival of agricultural productivity as we know it today.

The consequential devastation of the environment has resulted in part from large scale agricultural production practices. The development of chemical and capital intensive farming methods over the past four decades has been a primary focus of the United States Land Grant Systems (Liebman, 1992). Agricultural production, according to Chesters and Schierow (1985), is estimated to be the largest single nonpoint source of water pollutants. This includes salts, pesticides, fertilizers, sediments, and manures. Nonpoint pollutants account for up to 50% of surface water pollution. Giant monocultural cropping systems farming on highly erodible lands generate tremendous soil losses each year, and after 50 years of state and federal efforts to control severe soil erosion, it continues to be a major problem. Approximately 25 billion tons of

soil are lost to agricultural production systems yearly (Cunningham & Saigo, 1990).

Ecologically inappropriate farming and grazing practices are largely responsible for the destruction of our precious soil resources. These techniques may be used because of tradition, lack of information, or social and economic conditions that encourage destructive short-term gain instead of long term planning for a sustainable agriculture (Cunningham & Saigo, 1990, p. 182).

There are many alternative methods that can be utilized to avoid the threat of continuing severe soil erosion and reduce dangerous chemicals while improving production yields. These methods evolve from the development of recent scientific technologies as well as traditional successful farming practices (Cunningham & Saigo, 1990).

Traditional cropping systems must be integrated with environment-friendly rotational alternatives. The necessary safeguards for a continuing agricultural based culture must be established on a global basis, and re-established here at home. The survival of agricultural production on a self-sustaining basis in the United States and abroad continues to be a controversial concept.

One approach to addressing these challenges is a sustainable agriculture system. "Sustainable agriculture" is an integrated system of site specific plant and animal production practices. This system satisfies the long term human food and fiber needs and enhances environmental quality. It enhances the natural resource base upon which the agricultural economy depends and makes the most efficient use of nonrenewable and on-farm resources. It integrates natural biological cycles and controls and sustains the economic viability of farm operations. Finally, it enhances the quality of life for farmers and society as a whole. This was adapted from the 1990 Food, Agriculture, Conservation, & Trade Act (U. S. Department of Agriculture, 1994).

Many sustainable methods have been tried for years by the American farmer. These attempts at sustainable agriculture systems

have been individualized, are generally site specific, and are integrated with traditional methods, independent of adjoining farms or other production systems. A number of traditional agricultural teaching systems have addressed the need for a total integration of agricultural disciplines in production systems. However, this has been on a limited basis, and acceptance and the adoption of sustainable agriculture practices continues to evolve slowly. Research based, interdisciplinary problem solving methods need to be developed to address the promotion and implementation of agricultural production techniques advocating positive environmental benefits. There is also a need for the successful integration of research methods into various workable farm systems utilizing alternative production technologies (National Research Council, 1989). These research-based technologies must be made available by a delivery system that is on the very cutting edge of modern technology.

As the Cooperative Extension Service becomes increasingly involved with the implementation of concepts and practices of sustainable agriculture, several questions must be addressed. How are these concepts and the emerging need for a sustainable agriculture land base significant to the training needs of the Cooperative Extension Service? Can the Cooperative Extension Service provide the needed teaching services in the area of sustainable agriculture with present capabilities, or are changes needed in the qualifications of new professionals employed by the Cooperative Extension Service? Do the personnel presently assigned to agricultural program areas have the needed expertise to teach specific alternative agricultural concepts utilizing sustainable production methods? Are the agricultural production methods that are being taught and promoted by Cooperative Extension personnel conducive to a sustainable agriculture land base? Is it imperative that the Cooperative Extension Service undertake employee training in

sustainable agriculture concepts leading to the development of farm production practices reflecting the environmental concerns supportive of an emerging global agriculture?

Prior to this study, no research had ever been conducted to describe extension agricultural agents' perceptions of sustainable agriculture in the Southern Region of the United States. Therefore, this study was designed to address this problem.

Theoretical Framework and Research Model for the Study

An investigation into the process of adult learning as presented by Malcolm Knowles (1977) has indicated that the background characteristics (demographics) of individuals influence the way they perceive themselves. Because people identify and define themselves largely by past experiences, an older person having lived longer would not only have accumulated different kinds of experience over the years, but also a larger volume of experiences. Also, according to Knowles (1977), adults are actually; what they have done. Adults identify themselves in terms of a unique set of experiences that includes occupation, where they have worked, where they have traveled, what their training has equipped them to do, and what their achievements have been. Older individuals have acquired a larger number of fixed habits and thought patterns and therefore are less open-minded than younger individuals (Knowles, 1977).

These concepts were incorporated into an investigation of the following demographic characteristics of the respondents:

- 1) Age;
- 2) Agricultural background (farm experience, agricultural area in which the major amount of professional extension time was spent, clientele with whom largest segment of time was spent);
- 3) Type of institution of employment (either the 1862 institutions which were established by the Morrill Act of

1862 or the 1890 institutions established by the Second Morrill Act of 1890); and

- 4) Educational background (highest level of educational attainment, undergraduate major, graduate major).

These individual characteristics are the independent variables that are theorized to influence agents' perceptions of sustainable agriculture areas under investigation (concepts, factors and impacts, trends, capabilities of the Cooperative Extension Service in sustainable agriculture, and self-competencies of the agents in sustainable agriculture). The theoretical framework for this study maintains that the agents' perceptions of sustainable agriculture are based on the following fundamental and interrelated components:

- 1) State Cooperative Extension Service philosophy and expectations;
- 2) Technical agriculture training and experience of agents;
- 3) Sustainable agriculture research and theory;
- 4) Local producers' perceptions and practices; and
- 5) Human behavior patterns as related to perceptions.

This theoretical framework for the study is depicted in Figure 1.

The research model for the study was based on the theoretical framework depicted in Figure 1. The research model shows that agents' perceptions of sustainable agriculture are comprised of the following perceptions:

- 1) Perceptions of sustainable agriculture concepts;
- 2) Perceptions of factors impacting the sustainability of production agriculture;
- 3) Perceptions of sustainable agriculture trends;
- 4) Perceptions of the capabilities of the Cooperative Extension Service in sustainable agriculture; and
- 5) Perceptions of sustainable agriculture competence.

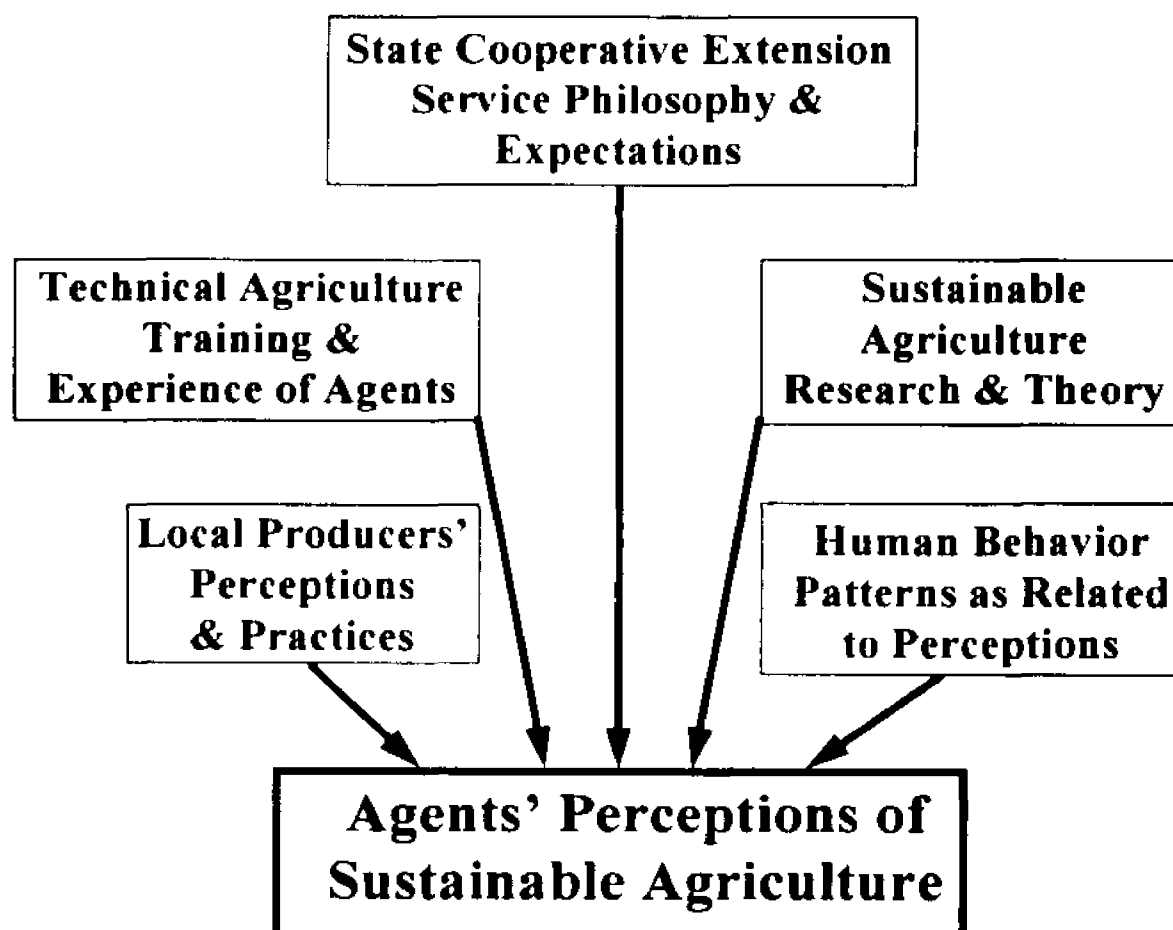


Figure 1.
Theoretical Framework for the Study

The variables listed on the previous page are the dependent variables in the study and are influenced by the following demographic characteristics (independent variables):

- 1) Age;
- 2) Agricultural background;
- 3) Type of institution of employment; and
- 4) Educational background.

The research model is depicted in Figure 2.

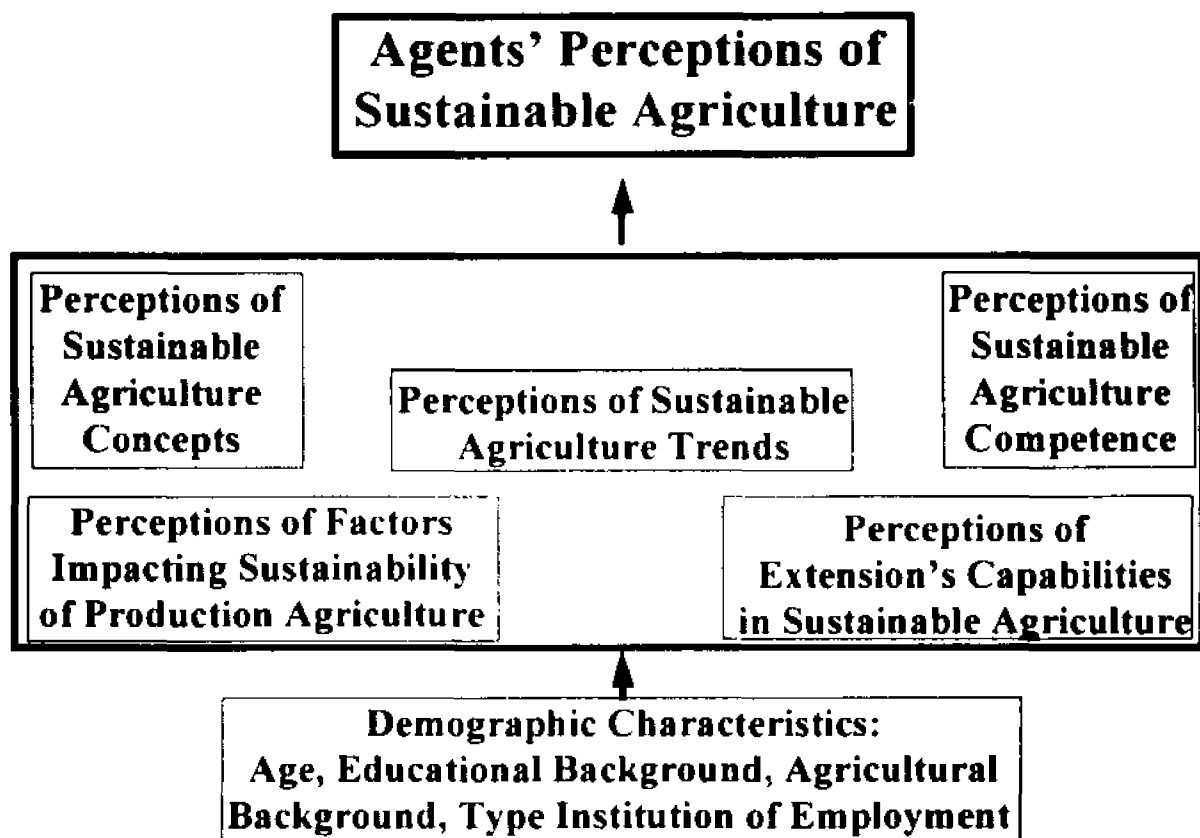


Figure 2.

Research Model for the Study

Purpose and Objectives

The purpose of this study was to describe extension agricultural agents' perceptions of sustainable agriculture in the Southern Region of the United States. Perceptions of the agents were investigated in this study as an indicator of knowledge and feelings about sustainable agriculture, in lieu of a more objective measure such as a test of agents' competencies.

The objectives of the study were to:

1. Describe the demographic characteristics of extension agricultural agents employed by the Cooperative Extension Service in the Southern Region of the United States.

2. Describe extension agricultural agents' perceptions of concepts of sustainable agriculture in the Southern Region of the United States.

3. Describe extension agricultural agents' perceptions of factors and their potential impact on the sustainability of production agriculture in the Southern Region of the United States.

4. Describe extension agriculture agents' perceptions of trends and their relationship to the future of sustainable agriculture in the Southern Region of the United States.

5. Determine extension agriculture agents' perceptions of sustainable agriculture capabilities of the Cooperative Extension Service in the Southern Region of the United States.

6. Determine extension agricultural agents' perceptions of competencies in sustainable agriculture in the Southern Region of the United States.

7. Determine if differences exist in extension agricultural agents' perceptions of sustainable agriculture concepts by age, agricultural background, educational background, and type of institution of employment.

8. Determine if differences exist in extension agricultural agents' perceptions of the potential impact of factors on the sustainability of production agriculture by age, agricultural background, educational background, and type of institution of employment.

9. Determine if differences exist in extension agricultural agents' perceptions of trends and their relationship to the future of sustainable agriculture by age, agricultural background, educational background, and type of institution of employment.

10. Determine if differences exist in extension agricultural agents' perceptions of capabilities of the Cooperative Extension Service in sustainable agriculture by age, agricultural background, educational background, and type of institution of employment.

11. Determine if differences exist in extension agricultural agents' perceptions of competencies in sustainable agriculture by age, agricultural background, educational background, and type of institution of employment.

Significance of the Study

This descriptive study was directed towards the gathering and interpretation of data related to sustainable agriculture in the thirteen states of the Southern Region of the United States. This region includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. Although these data are specific to the Southern United States, and to these states' Cooperative Extension Services, findings also may be applicable to characteristics of state Cooperative Extension Service organizations in other areas of the United States, and Extension Service organizations in other places in the world.

Extension agricultural agents of the Cooperative Extension Service at the grass roots level would seem to be knowledgeable about the significance of agricultural program thrusts. Agents having daily contact with producers can more effectively evaluate the successes and failures of national agricultural policies. These Cooperative Extension Service professionals are also in direct contact with their peers and administrators and, therefore, act as liaison between the producer and the agricultural policy maker.

Following the completion of this study, Cooperative Extension program development personnel will be able to more easily identify strengths and weaknesses of agricultural agents in sustainable

agriculture, and to address the unique needs and diversities of extension agricultural personnel working with producers using sustainable agriculture practices. The results of this study may prove to be an effective resource tool for addressing and modifying traditional agricultural practices, and for training in sustainable agriculture.

Information generated from this study should 1) indicate potential needs of extension agricultural agents of the Cooperative Extension Service for training in sustainable agriculture, 2) yield data identifying present capabilities of the Cooperative Extension Service in addressing the concepts, issues, and practices related to sustainable agriculture, and 3) provide demographic information to be used in the foundation of future training for Cooperative Extension Service agricultural agents. This study may also create renewed interest in the integration of agricultural disciplines and introduce a focus on renewed Cooperative Extension Service efforts to address this emerging need. Implications resulting from this study also may be pertinent to the design and implementation of future programs dealing with sustainable agriculture training.

Definitions of Terms

The definitions of terms below are intended to aid the reader in understanding the nature and conduct of this research.

Agriculture. The science, art, and business of farming (American Heritage College Dictionary, 1993).

Agro- or agri- or agr-. Field; soil; agrology. Agriculture: agroindustrial (American Heritage College Dictionary, 1993).

Agrochemical. A chemical, such as an insecticide, that improves the production of crops. A chemical or product derived from plants (American Heritage College Dictionary, 1993).

Agroecology. The term agroecology can be defined very broadly or very narrowly. Agroecology, loosely defined, often incorporates

ideas about a more environmentally and socially sensitive approach to agriculture. This definition focuses not only on production, but also on the ecological sustainability of the productive system. This definition implies a number of features about society and production going well beyond the limits of agriculture.

The most narrow definition of agroecology refers to study of the purely ecological phenomena within the crop field, such as predator/prey relations, or crop/weed competition. (Hect, 1987)

Agro-ecosystems. Man made environments. These systems pose ecological problems through interactions between crops and grazing animals, between cropping and cultivation systems and the soils, between natural wild life and the domesticated organisms; also in the impact of agricultural ecosystems on other parts of the environment (e.g. through leaching of nutrients into lakes and waterways), and in activities that impinge on agricultural systems from outside for example; industrial pollution, outdoor recreation (Agro-Ecosystems, 1977).

Agroindustrial. Of or relating to the production or supply of various needs, such as water or power, for agriculture and industry. (American Heritage College Dictionary, 1993).

Concept. A general idea derived or inferred from specific instances or occurrences. Something formed in the mind; a thought or notion. (American Heritage College Dictionary, 1993).

Cooperative State Research Systems. Extension educational programs are in large part research driven. States have a number of experimental research stations throughout the state that work closely with the land grant institutional systems (Extension Service, U. S. Department of Agriculture, 1983).

Ecology. The science of the relationships between organisms and their environments. The relationship between organisms and their environment. (American Heritage College Dictionary, 1993).

Extension agricultural agent. An extension agent having primary responsibility in agriculture with adult farmers, but who may also be doing 4-H youth work. (Extension Service, U.S. Department of Agriculture, 1983).

Extension Service, USDA. This system represents the federal partnership and provides national leadership, and program information to the state partners and to the public (Extension Service, U.S. Department of Agriculture, 1983).

Low Input Sustainable Agriculture (LISA). With initial appropriation in 1987, LISA was USDA's research and education grants program, organized and directed by the Cooperative State Research Service (CSRS) and Extension Service (ES). The 1990 Farm Bill expanded the program and subsequently renamed it the Sustainable Agriculture Research and Education (SARE) program. (U.S. Department of Agriculture, 1990).

Perceive. To become aware of directly through any of the senses, especially sight or hearing. To achieve understanding of; apprehend. (American Heritage College Dictionary, 1993).

Perception. The process, act, or faculty of perceiving. (American Heritage College Dictionary, 1993).

State Cooperative Extension Service. Each state has a local Cooperative Extension Service in every county/parish. This is part of a three-way state educational system composed of 1) the land grant teaching institutions. (This includes the 1862 institutions which were established by the Morrill Act of 1862, and the 1890 institutions established by the Second Morrill Act of 1890.) 2) the Cooperative State Research Systems, and 3) the Cooperative Extension Service which acts as the local teaching arm of the university and the research stations (Extension Service, U.S. Department of Agriculture, 1983).

State Land Grant University System. This system serves as the coordinator for the Cooperative Extension Service in each state. The state Cooperative Extension Service institutions work with both the federal and local partners (Extension Service, U.S. Department of Agriculture, 1983)

Sustain. To keep in existence; maintain. (American Heritage College Dictionary, 1993).

Sustainable agriculture. Sustainable agriculture means an integrated system of plant and animal production practices having a site specific application that will, over the long term, satisfy human food and fiber needs; enhance environmental quality and the natural resource base upon which the agricultural economy depends; make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole. Taken from the Food, Agriculture, Conservation, and Trade Act of 1990; Public Law 101-624, Title XVI, Subtitle A, Section 1603 (U.S. Department of Agriculture, 1990).

Sustained yield. The continuing yield of a biological resource, such as timber, by controlled periodic harvesting. The quantity of a resource so harvested. (American Heritage College Dictionary, 1993).

CHAPTER 2: REVIEW OF LITERATURE

Agroecological Problems

Fertilizers

According to Brown, et al. (1985), the world used less than 14 million tons of chemical fertilizers in 1950. Within ten years, that figure doubled. At a minimum, a billion and a half people are now fed with the additional food produced with chemical fertilizer. As the stork outruns the plow, the role of fertilizer increases (Brown, et al., 1985).

During the years from 1921 to 1931, the average annual consumption of fertilizers in the United States stood at 6,901,000 tons (Hutcheson, Wolfe, & Kipps, 1936). The total commercial fertilizer applications increased from ten million tons in 1942 to over twenty million tons by 1952. At that time the most significant trend in fertilizer use was the ready availability, the lower cost, and the increased use of nitrogen fertilizers. The extremely low cost of nitrogen from synthetic fertilizers created a massive replacement of legumes after 1950 as the traditional source of nitrogen in cropping systems (Tauer, 1989).

American farmers spent over \$7 billion for fertilizers in the year 1985 to produce over \$70 billion in crops. By 1989, world fertilizer consumption totaled 143 million tons (Brown, et al., 1990).

Soil Erosion

Soil erosion is not a new concept, but has been tossed around by authors, researchers, and soil scientists for many years. The problems cited as being detrimental to the agricultural production areas of the United States were discussed by several authors over thirty years ago.

"Soil erosion, along with continuous cropping, has lowered the organic content of many soils. They are kept productive only by use of large amounts of commercial fertilizers, improved seed, insecticides, and weed control chemicals" (Knuti, Korpi, & Hide, 1962, p. 33).

The problems associated with agricultural practices and resulting degradation of the lands were also highlighted by these authors. "Continuous cultivation and planting of row crops have lowered the tilth of many soils because much of the organic matter and humus in the soil has been burned out or used up" (Knuti, Korpi, & Hide, 1962, pp. 36, 37). "When man cuts down the trees on stabilized lands, plows up the soil, and grazes the plains, the protective cover is destroyed and man-made erosion becomes uncontrolled. Man has created all of the destruction of natural resources that we know as erosion" (Knuti, Korpi, & Hide, 1962, p. 258).

Warnings that were sounded years ago seem similar to many that are presently being heard.

The misuse of our natural resources has resulted in losses of rich topsoil and soil fertility, damage and/or ruination of millions of acres of crop lands. Our water resources are menaced by severely dropping water tables, polluted streams, silting reservoirs, and increasing water shortages (Knuti, Korpi, & Hide, 1962, p. 261).

Six years earlier Roberts, et al., (1956), discussed the continuing problems of soil erosion and predicted that if it was not controlled, a corresponding reduction in food production was likely to follow.

The U.S. Department of Agriculture estimates that over 50,000,000 acres of cropland have been destroyed by erosion, and more than three-fourths of the original surface soil has been lost on 282,000,000 additional acres. It is estimated that about 75 per cent of the total cropland area is subject to erosion and unless conservation measures are practiced this land will eventually be depleted of its soil fertility.... The average depth of the topsoil in the United States at present is estimated at about 5 or 6 inches. The average depth of topsoil was about 9 inches before the land of the United States was used

to grow crops. About one-third of the topsoil has been lost in a relatively short time. Unless conservation measures are practiced this loss will continue with a consequent reduction in the capacity of the land to produce food (Roberts, et al., 1956, p. 542).

Pesticides

As this country moved into the years prior to and during World War II, the promotion and the use of synthetic pesticides came to the forefront of the agricultural movement. Through the early years of the 1940s, corn received very little or no insecticides, and crop losses to insect pests were about 3.5%. Since that period, insecticide use on corn has grown more than 1000-fold, and corresponding loss due to insects has grown to 12%. Since 1945, the use of synthetic pesticides in the United States has grown 33-fold (Pimentel, et al., 1991). DDT (dichloro-diphenyl-trichloro-ethane) as an insecticide was developed in 1940, and 2,4-D (2,4-dichlorophenoxyacetic acid) was developed as a herbicide in 1941 (Troeh, Hobbs, & Donahue, 1980). The management and control of weeds in agricultural fields that had been controlled by using crop rotation, tillage methods, and competitive or "smother crops" became increasingly dependent on herbicide usage over the years. The continuing use of mechanical methods with crop rotations and competitive crops has declined since then, due largely to the advent of economically available chemicals, and the emergence of mechanized technology. Today's agriculture is energy intensive and supported by manufactured inputs, electricity, and available fossil fuels. The use of machinery, fuels, pesticides, fertilizers, and irrigation all influence increased agricultural production, but accomplish this with resulting ecological and social problems (Altieri, 1992).

DDT (dichloro-diphenyl-trichloro-ethane) as an insecticide was recommended in 1949, for control of insects on grazing crops and a number of vegetables (Murphree & Lyle, 1949), and for in-house use in the form of sprays, dusts, and aerosol sprays to control moths, ants,

and mosquitoes (Floyd, 1948). Aerial spraying with DDT was found effective in the prevention of insect epidemics in forests, and about 1.5 million acres were sprayed annually at rates of one pound per gallon of solvent (Highsmith, Jensen, & Rudd, 1962). Newer, easier, more economical methods of pest control had come to the forefront. The generation of the 40s was ignorant of the far reaching effects of many agricultural pest control practices that were considered safe at the time by those in the know.

The research based information that was passed on to the populace may have had, in many instances, catastrophic outcomes for those involved when applied to real situations. Present knowledge affirms severe ecological and environmental degradation due to the long-term intensive use of large numbers of chemical pesticides. The bioaccumulation and magnification of persistent chemicals such as DDT in the food chain has culminated in toxic levels in many carnivores. These include the bald eagle, peregrine falcon, brown pelican, salmon, seal, and humans. Many endangered species are threatened by pesticide poisoning (Cunningham & Saigo, 1990).

Total pounds of pesticide active ingredients applied on farms increased 170 percent between 1964 and 1982, with total cultivated acreage remaining relatively constant. Herbicides were used most: from 210 million pounds in 1971 to 455 million pounds in 1982 (U.S. Department of Agriculture, 1984). The total dollar value of the domestic agricultural pesticide market stood at about \$4.0 billion in 1986, with herbicides representing the largest portion at \$2.5 billion, insecticides at \$1.0 billion, and fungicides at about \$265 million (National Agricultural Chemicals Association, 1987). Nearly half of the pesticides used in the United States are used in corn production, 55% of herbicides and 44% of all insecticides used on field crops (National Research Council, 1989).

In 1945 crop losses in the United States caused by insects, diseases, and weeds amounted to 32 percent of the harvest. In 1980 these losses had risen to 37 percent of the harvest despite the use of 450,000 metric tons (1 billion pounds) of pesticides.... In a 1985 survey by the National Institute of Environmental Health Sciences 100 percent of the Americans tested had detectable DDT residues in their body, and 90 percent also had traces of chlordane, heptachlor, aldrin, dieldrin, or hexachlorobenzene.... The World Health Organization estimates that there are 2 million pesticide poisonings in the world each year, and that at least 10,000 people die of immediate pesticide effects.... Of the six hundred active pesticide ingredients on the market, the EPA has completed a preliminary assessment of only 20 percent. These active ingredients are combined with another nine hundred chemical solvents, thickeners, propellants, stabilizers, adsorbents, and other "inert" ingredients to make more than 50,000 commercial products. The EPA estimates that it will take twenty years to test all the products now on the market (Cunningham & Saigo, 1990, p. 200).

A study by Pimentel, et al. (1991) investigated the economic and environmental advantages of reducing overall pesticide use in the United States by one-half. According to the results of this study, this is feasible with no decrease in crop yields or loss in "cosmetic standards". Increased costs to the consumer for food products would be 0.6%. Denmark, Sweden, and the Netherlands presently have programs similar to this. Where might be the beginning for this level of pesticide reduction by agricultural producers? Research reveals that a practical decision aid for the producer and other pesticide users has been developed by the Florida Cooperative Extension Service and also by the USDA/Soil Conservation Service (Hornsby, Buttler, & Brown, 1993). Both address the environmental fate of the pesticide and soil properties at the site of application. These evolving technologies not only will help pesticide users select pesticides for a significant reduction in impact on water quality, but also will provide regulatory agencies a practical basis for groundwater protection plans.

Projected Agroecological Impacts

The discussion by Ruttan (1992) in the publication, "Sustainable Agriculture and the Environment: Perspectives on Growth and Constraints", voiced concerns about the environmental impact of

agricultural intensification into the 21st century. Major concerns included: 1) soil erosion and salinization; 2) groundwater contamination from plant nutrients and pesticides; 3) increased resistance of pathogens, weeds, and insect species to present control methods; and 4) land use changes, agricultural production, and the resulting impacts on the changing global climate.

To these four, add six more from Schaller (1993): 1) hazards to animal and human health from pesticides and feed additives; 2) loss of genetic diversity in plants and animals; 3) destruction of wildlife, bees and beneficial insects by pesticides; 4) over-reliance on non-renewable resources; 5) health and safety risks for farm workers who apply potentially dangerous chemicals; and 6) agricultural chemicals' adverse effects on food quality and safety.

Eight emerging research implications directed at contemporary issues and problems associated with agricultural production and predicted climate changes are suggested by Ruttan (1992) in the above mentioned publication:

- 1) A serious effort should be initiated to develop alternative land use, farming systems, and food systems scenarios for the 21st century.
- 2) The capacity to monitor agricultural sources and impacts of environmental change should be strengthened.
- 3) The design of technologies and institutions to achieve more efficient management of surface and groundwater resources will become increasingly important.
- 4) The modeling of the sources and impacts of climate change must become more sophisticated.
- 5) Research on environmentally compatible farming systems should be intensified.
- 6) Efforts should be made to reform agricultural commodity and income support policies.

- 7) Alternative food systems will have to be developed.
- 8) A major research program on incentive compatible institutional design should be initiated.

Agroecological Problems in Other Countries: Current Attempts at Solutions

The United States is not the only country which is finding the degradation of the environment as of the last twenty years to be an unequal compensation for increased agricultural production. It also is not the only country to witness upheavals in traditional agricultural thinking and production concepts, and polarization of farmers as traditionalists or as organic or low-input producers.

Just how are other countries dealing with the environmental problems which have followed the technological advances and the increased yields of current production practices? What does history show about the evolvement of high yielding agricultural practices in selected countries, the resulting environmental degradation, and more recently, the implementation of policies to address this issue? Agriculture in China and Australia are briefly discussed as examples of the common nature of this problem.

Agriculture in China

The United States has about 1.9 billion hectares and feeds over 250 million people. By contrast, China feeds about 1.1 billion people from about 1 billion hectares of land. Despite its relatively limited land area, however, China is still the largest world producer of both wheat and rice (Cunningham & Saigo, 1990).

Agriculture in China has existed for centuries. Prior to the 1950s and the increased agricultural production due to the use of hybrid seeds and fossil energy derived inputs such as synthetic fertilizers and pesticides, the country was unable to feed its teeming millions. The increased agricultural production has led to severe environmental degradation and a noticeable shortage of major

agricultural resources. The rapidly increasing population and the inevitable demands placed on Chinese agriculture have led to the development of more ecological management practices to address the need for more productive as well as sustainable agriculture production systems (Wen, et al., 1992).

Since the 1950s, crop yields have tripled. These higher yields have made it possible for China, which has only 15% of the world's arable crop land, to produce 21% of the world's total grain and feed 1.16 billion humans, who comprise about 23% of the world's population. Clearly, this has been a major achievement for Chinese agriculture (Wen, et al., 1992).

Among the more innovative agroecological practices which are now widely used in China are:

- 1) Intercropping and multiple cropping;
- 2) Minimum tillage and conservation tillage;
- 3) Application of green manures and other organic fertilizers;
- 4) Water-saving cultivation techniques for rice and other crops;
- 5) Cultivation of common duckweed and/or fish in paddy rice fields;
- 6) Combined aquaculture and crop production systems;
- 7) The development of various agro-forestry systems;
- 8) The integrated use of crop residues and other agricultural wastes for cultivating mushrooms, feeding animals, and producing biogas;
- 9) Intercropping of corn with sweet clover;
- 10) Relay intercropping of wheat with corn and multiple-cropping of wheat with vegetables; and
- 11) Intercropping of sugar cane with vegetables in the middle rows from March to June and cultivation of mushrooms and

black fungi in the middle rows from September to December (Wen, et al., 1992).

According to these authors, such practices can be implemented only with the increased ecological consciousness of the people of China. However, the development of courses in agroecology at thirty agricultural universities in China has led to many groups teaching and studying agroecology.

Three-fourths of the total population of China reside in the countryside, and many of these are involved in agricultural production. The availability of these millions of people as labor may prove favorable to the development of labor intensive production addressing a more sustainable agriculture in China.

Agriculture in Australia

Australian agriculture has grown since European settlement some two hundred years ago. The early pioneers cleared and tilled land for growing crops and animals, and Australian agriculture has grown from this through many phases to present day agriculture (Sriskandarajah, & Dignam, 1992).

The sustainability of agriculture, as discussed by Sriskandarajah and Dignam (1992), questions just what we want to sustain. Do we wish to sustain the productive capacity of the physical environment, the productivity of the individual farm, the quality of life in the rural communities, or the income generated from the commodities produced by the rural agriculturists?

These authors advocate changes in thinking strategies in order to address the complexities of the ethical, economical, and ecological issues which confront the population of today. According to their study, the main thrust in Australia has been the search for ways to sustain agricultural productivity without degradation of the environment, and the search for measures to redress effects of past farming practices. They argue for a supportive, collaborative

agricultural movement, which uses alternative production methods, is empowering of the people involved, and constantly questions the constructs of sustainable agriculture.

The comprehensive causes of land degradation in Australia as provided by Burch, Graetz, and Noble (1987) are as follows:

- 1) Intensification of land use;
- 2) The degree of land clearing;
- 3) Tillage practices;
- 4) Soil acidification of pastures;
- 5) Irrigation pollution;
- 6) Chemical pollution;
- 7) Fire management; and
- 8) Stock management.

Present movements in Australia which are directed at a more sustainable agriculture in concert with a stable environment include the following:

- 1) The National Soil Conservation Strategy aims to marry goals of conservation and development in a national land-use planning framework which will support a sustainable society.
- 2) The National Soil Conservation Program is a \$45 million dollar initiative directed toward implementation of national policies for rehabilitation and sustainable use of the nation's soil and land resources, with emphasis on community-based soil conservation action groups.
- 3) The National Tree Program was organized to conserve and establish trees and associated vegetation for community and private benefit throughout Australia.
- 4) Landcare was the first comprehensive approach to conservation of soil, water, flora, and fauna. Landcare's mission is to develop a landcare ethic among all

Australians through participation and to raise consciousness of the fact that only careful management of the land and all its resources will maintain their present way of life and that of future generations.

- 5) Saltwatch deals with increased salinity levels caused by irrigation over many years. Through groups, farmers are becoming more aware of the implications of irrigation practices to surrounding properties in the form of salinity and rising water tables, and are working to address these problems. Community awareness of the salinity problems was brought to focus by school programs whereby school children measured salinity levels of area properties.
- 6) The National Association of Sustainable Agriculture Australia is a coalition of groups whose mission is to promote systems of agriculture which emphasize land stewardship, good husbandry and the production of healthy food. NASAA lists as its main thrusts to establish and maintain standards for agricultural products, to develop an infrastructure to support these standards and to assist with the marketing of these products.
- 7) The Commonwealth Scientific and Industrial Research Organization has as its six main project thrusts: salinity control, including groundwater discharge, tree planting and irrigation strategies; crop, soil, and water management for the southeast wheat belt; management of rangelands for sustainability and restoration; land degradation assessment and forecasting; decision support systems for assessing and restoring degraded arid and semi-arid grazing lands; management to reduce land and water degradation, sediment movement, and wind erosion; rotation of crops for cropping and grazing systems; and adoption of computer modelling and

systems for integrated management of irrigated crops such as cotton, and crop-livestock integration (Sriskandarajah & Dignam, 1992).

According to the above authors, a shift in focus from productivity to sustainability in land use is needed, as well as a shift in the perceptions and world view of the people concerned, and empowerment of those people to action. This will successfully bring about the development of appropriate educational programs, cooperation between farmers, extension workers, and researchers, and finally, changes in the approach to research.

Educational institutions have been preoccupied with the transmission of knowledge as a commodity, divided into the various disciplines, to produce expert technologists. Researchers, working in isolation from farmers, have been looking at components of a farming system rather than the system itself, often with the objective of improving productivity. In this quest for productivity, the role of the extension worker was in the transfer of new technology developed by the researcher to the more innovative and generally better-off farmers, and not necessarily to a wider cross-section. The relative inadequacy of the technology transfer model of extension in serving the complex agricultural systems of today, compared with the newer tradition of human resource development, is highlighted in a recent review by Russell, et al. (1989).

Systems agriculture, an innovative approach providing for learning needs of people at all levels through collaborative processes, draws from experiential learning and systems thinking. This process empowers farmers, researchers and extension workers to participate in research and has emerged over a ten year period through the work of staff and students of the Faculty of Agriculture and Rural Development at the University of Western Sydney. Learning

is central to this precept, and education, research, and extension are different facets of the one process of learning.

Clearly, the people of Australia are working toward a more sustainable agriculture land base through community involvement and empowerment concepts.

The Sustainability of Agriculture

Sustainability, as discussed by Lynam and Herdt (1992), has become the latest criterion for definition and evaluation of agricultural development and agricultural technology. Current interest is pursuant to implications for the environment and human welfare as it is affected by a dwindling agricultural resource base in many areas of the world. This seems to be indicative of a concern for the conservation of the resource base here at home.

In a recent study, Ori (1992) suggested four areas of importance in the promotion of sustainable agriculture: 1) give the public greater information regarding the environment, 2) develop technologies to extend the environmental agricultural resource base while reducing damage, 3) incorporate the ecological dimensions of the economy, trade, and industry into agricultural policies, and 4) encourage population control.

According to Altieri (1992), the basic principles of an agroecosystem vying for sustainability should include the following: conservation of renewable resources, adaptation of the crop to the environment, and maintenance of a moderate but sustainable level of productivity. The long-term achievement of sustainability can be enhanced through the reduction of energy and resource usage; the reduction of nutrient losses; the encouragement of local production of food items that are adapted to the socioeconomic as well as the natural setting; and sustainability of a desired net output by preservation of the natural resources and reduction of costs, thus

increasing efficiencies and the economic viability of small and medium sized farms.

Altieri also presents, from a management viewpoint, the four basic ingredients of a sustainable agriculture production system: 1) vegetative cover as an effective soil-and water-conserving measure met through the use of no-till practices, mulch farming, use of cover crops, etc.; 2) regular supply of organic matter through the addition of organic matter (manure, compost) and promotion of soil biotic activity; 3) nutrient recycling mechanisms through the use of crop rotations, crop/livestock mixed systems, agroforestry and intercropping systems based on legumes, etc.; and 4) pest regulation assured through enhanced activity of biological control agents, achieved by introducing or conserving natural enemies.

The concerns voiced by major institutions regarding the sustainability of agriculture, according to Lynam and Herdt (1992), address major areas such as tropical deforestation, soil erosion, loss of genetic diversity in crop species, agrochemicals and their effect on the environment, and the far-reaching effects of global warming on agricultural production.

Harwood (1990), categorized the developing agendas for sustainable agriculture in the United States into five broad categories: 1) Increase the utility of agriculture, 2) Increase productivity, 3) Maintain an environment favorable to humans and most other species, 4) Assure the ability to evolve indefinitely, and 5) Develop patterns of geographical distribution and scale (macro structure) consistent with national agendas.

According to Harwood (1990), agriculture of the future must become increasingly more productive and more efficient in the use of resources. Biological processes within agricultural systems must be more controlled from within than by externalities, and farm nutrient cycles within the farm must be more closed.

Five processes that need to be undertaken by the international agricultural research centers in order to address the sustainability of agricultural production systems, as presented by Lynam and Herdt (1992), follow:

- 1) Recognize the need for sustainability in agricultural production systems;
- 2) Define appropriate methods of measuring sustainability;
- 3) Empirically examine the sustainability of a well-defined farming system;
- 4) Define the externalities existing in such a system; and
- 5) Develop methods whereby we can measure these externalities.

Defining Sustainable Agriculture

Before attempting to enter into a study designed to investigate perceptions of sustainable agriculture in the Southern Region of the United States, and competencies in sustainable agriculture practices of Cooperative Extension agricultural agents, it is imperative that there be an established working definition of "sustainable agriculture."

According to Edwards, et al. (1993), concerns regarding the degradation of natural resources resulted in a recent response leading to the development of the concept of sustainable agriculture. The concept of sustainable agriculture was probably first outlined by Jackson (1980) and Rodale (1983), with the use of the concept of a regenerative agriculture that renewed natural resources. This concept emphasized the integrity of the agricultural ecosystem and the importance of renewal capabilities. Supporters for this concept claimed that many conventional agricultural practices were detrimental to renewal capabilities. Also, according to Edwards, et al. (1993), this concept, following the promotion of extensive discussion, evolved into a sustainable agriculture framework, integrating the principles of ecology, and emphasizing interactions

of the biological components of the agri-ecosystem. During the mid 1980s, more and more groups and organizations recognized the need for adjustments to the traditional farming methods. These adjustments were proposed for an ensuing more environmentally, socially, and economically compatible agriculture. The phrase sustainable agriculture was developed for use indicative of a global agriculture that conserved natural resources while providing for the needs of present and future generations (Douglass, 1984). Used in this context, the phrase sustainable agriculture or sustainable development refers to agriculture and all interactions with society (Edwards et al., 1993).

The term "sustainable agriculture" was defined by Congress in the Food, Agriculture, Conservation, and Trade Act of 1990 (Farm Bill). Under this act, the term "sustainable agriculture" was defined as follows:

Sustainable agriculture means an integrated system of plant and animal production practices having a site specific application that will, over the long term: satisfy human food and fiber needs; enhance environmental quality and the natural resource base upon which the agricultural economy depends; make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole. Food, Agriculture, Conservation, and Trade Act of 1990; Public Law 101-624, Title XVI, Subtitle A, Section 1603 (U.S. Department of Agriculture, 1994).

Sustainable farming practices vary from farm to farm but commonly include:

- 1) Crop rotations that mitigate weed, disease, insect, and other pest problems; increase available soil nitrogen; reduce erosion; and reduce risk of water contamination by agricultural chemicals;
- 2) Pest control strategies that are not harmful to natural systems, farmers, their neighbors, or consumers, which include integrated pest management techniques that reduce

the need for pesticides by practices such as scouting, use of resistant cultivars, timing of planting, and biological pest controls; and

- 3) Increased mechanical/biological weed control; more soil and water conservation practices; and strategic use of animal and green manure crops (U.S. Department of Agriculture, 1994).

American Agriculture and the Cooperative Extension Service

During the year of 1846, the agricultural industry in the United States was struggling. Although many reformers promoted crop rotation, improved fertilization methods and other scientific crop production concepts, few farmers listened. Father-to-son training carried on traditional methods of past generations. Attempting to meet the needs of the emerging agricultural and industrialized society, Maryland, Michigan, Iowa, and Ohio created agricultural colleges. In Pennsylvania, a farmers' high school was created. State legislatures pressured Congress to take action.

The Morrill Act passed by Congress in 1862 was to become a landmark for the beginnings of higher education. By accepting the 30,000 acres offered to them, the states agreed to establish and operate at least one college, teaching military science, agriculture and the mechanical sciences, without excluding other sciences or classical studies. This legislation provided seed money for development of the land grant universities, as we know them today, and placed instruction in areas of agriculture and home economics in American higher education. The passage of the Hatch Act in 1887 created agricultural experiment stations within each land-grant institution to establish a research base for the development of scientific agriculture. The second Morrill Act passed in the year 1890, created the 1890 land grant colleges (Extension Service, U.S.

Department of Agriculture, 1983). This legislation provided similar educational opportunities for African-Americans.

The Cooperative Extension Service was created by Congress in the year 1914, by the provisions of the Smith-Lever Act for the purpose of diffusing among the people of the United States useful and practical information on subjects related to agriculture and home economics, and to encourage the application of same. The Cooperative Extension Service was created as the third part of the Land Grant System, including resident instruction, and Cooperative State Research. The Smith Lever Act also provided for \$10,000 per state, plus a formula for distributing the remainder of federal funds to the states on the basis of rural population, a formula which continued until 1923. The successful contributions of the Cooperative Extension Service brought about accelerated growth in average farm production as well as median farm family income, and an overall positive direction for the American economy (Extension Service, U.S. Department of Agriculture, 1983).

Subsequent to the year 1928, support for the Cooperative Extension Service gained momentum, resulting in the promotion and the development of new agricultural production technologies. The passage of the Capper-Ketchum Act provided for the expansion of the Cooperative Extension Service with \$1.5 million in additional federal funds. One-third of these funds was required to be matched by the states. A national temper advocating expansion of the Cooperative Extension Service provided equally expanded Federal monetary support during ensuing years (Extension Service, U.S. Department of Agriculture, 1983).

The many contributions of the Cooperative Extension Service to the growth and economic development of the country through improved agricultural production methods is generally unquestioned. The phenomenal growth in agricultural crop production, the important

changes in planting and harvesting practices and improved plant varieties, and the successes and contributions of agricultural research and development to the American farm family were all responsible for raising the living standards for many other Americans.

We have seen the determination for a better lifestyle for the populace being brought about by change. In the 1930s, rural electrification, the improvement and modifications of agricultural methods by the use of mechanized labor, the farm tractor, improved methods of cropping, and a new emphasis on synthetic fertilizer application developed as population growth accelerated. The demonstration farms utilized the new agricultural production techniques, new crop varieties, and pest control methods to teach agriculture. Surely, as shown by the teachings of Seaman A. Knapp, considered by many to be the father of the demonstration method, seeing is believing.

The American farmer produced good crops during the years from 1939 to 1948. These excellent crops were partially due to such factors as the efforts of farmers who worked longer hours; to the improvement of hybrid corn; and to the increased use of soil improvement practices, such as cover crops, planting of legumes, terracing, farming on the contour, and the addition of fertilizers, manure and limestone (Roberts, et al., 1956, p. 9).

The Role of the Cooperative Extension Service in Sustainable Agriculture

Can many of the patterns presently in place in other areas of the United States and other countries be successfully adapted and implemented in the Southern Region of the United States? If so, what are the responsibilities of the Cooperative Extension Service as the leading national and regional agricultural teaching entity? The introduction of site specific integrated agricultural practices by researchers, extension technologists, local agricultural agents, and innovative farmers will have to have a beginning somewhere. The invitation to producers to assist as researchers on-site, with

knowledgeable university personnel assisting with the implementation of the integration of disciplines, has been initiated in many areas of the country during the past few years and will continue to build data banks for the future (Extension Service, U.S. Department of Agriculture, 1993).

The passage of the Food Security Act of 1985 was indicative of a changing political climate in the United States and an increasingly favorable atmosphere directed toward a national agricultural system regulated by more environmentally sound practices (Liebman, 1992). This act created the Low Input Sustainable Agriculture (LISA) program and provided an initial \$3.9 million budget in 1987. Through Subtitle C of this legislation, the USDA was to establish research and education efforts to promote the adoption of low-input agricultural production systems. The 1985 farm bill mandated research into these alternative production systems, addressed reduction of reliance on purchased inputs, and encouraged soil-building, and non-depleting (sustainable) farming practices (U.S. Department of Agriculture, 1991). These alternative systems were to be developed for the purpose of reduction of production costs, soil erosion, and ground water pollution (Liebman, 1992). Also, according to Liebman, a noteworthy characteristic of the LISA program was the substitution of scientific know-how, skilled management, on-farm resources, and ecological processes for purchased feeds, pesticides, synthetic fertilizers, and other inputs that are external to the system.

Between 1988 and 1990, \$12.8 million of grant funding for the LISA program was distributed through coordinators in four regions of the United States. Recipients included farmers, non-governmental organizations, university researchers and educators, public agencies, the Soil Conservation Service, and the Cooperative Extension Service (Liebman, 1992).

Investigation into perceptions of sustainable agriculture in the American South was conducted in a USDA funded study by Huston and Rhoades (1994). This study was a joint effort between the University of Georgia's Department of Anthropology and the University of Arkansas' Cooperative Extension Service. Results were presented in a paper to the Southern Anthropological Society Key Symposium April 27-30, 1994, in Atlanta, Georgia.

The project was designed to measure perceptions of sustainable agriculture and dealt with five populations of stakeholders in Southern agriculture: 1) Cooperative Extension agents and soil conservationists; 2) Conventional farmers (Farm Bureau Presidents); 3) Farmers interested in agriculture (subscribers to Rodale Press' New Farm Magazine); 4) Environmentalists (Sierra Club members); and 5) Members of the Southern Sustainable Agriculture Working Group (SSAWG). Areas investigated by the study included perceptions of each group toward: the extent of current participation in sustainable practices by producers; problems currently faced by members; the extent of current educational and research programs on sustainable practices; constraints working against producers that prevent implementation of further sustainable practices; needed areas of educational and research efforts; and constraints facing respondents in their efforts to implement and promote increased sustainable agriculture practices.

Results of this study indicated that there were statistically significant differences at $p < .05$ in perceptions by the different groups toward many of the areas being investigated, thus setting the stage for further research into sustainable agriculture concepts and practices.

What do these changes that we have seen yesterday, are seeing today, and will see in the future actually mean to the changing faces and roles of those who serve the Cooperative Extension Service?

Should the Cooperative Extension Service attempt mandated training of its personnel as directed by the 1990 Farm Bill in order to develop their understanding, competence, and abilities to teach and communicate the concepts to cooperating agricultural producers?

The agricultural agents of the Cooperative Extension Service must be thoroughly knowledgeable in the areas of sustainable agriculture in order to be able to establish creditability as agricultural leaders in their immediate area. The understanding and the applications of current sustainable agriculture production technologies by these agents are imperative to the continued national agricultural leadership of the Cooperative Extension Service.

Extension agents need to be highly integrated with the research establishment in order to enable them to communicate a level of knowledge and technical skills exceeding that of user groups for whom they provide information and training. Without the establishment of a close interaction and communication with research scientists, their influence as extension agents is greatly diminished (National Research Council, 1987).

Hoag and Pasour (1992) of North Carolina State University in a recent article present the point that adequate research has not been undertaken to support the objectivity of the Extension Service in the area of sustainable agriculture. If the Extension Services follows the training requirements of the 1990 Farm Bill, it might force the Extension Service agents to: 1) advocate a farming system that has inadequate research support, or 2) give lip service to be politically correct, while carrying on traditional agri-oriented activities. Hoag and Pasour also question the broad-spectrum support generated for the sustainable agriculture movement. The vagueness of sustainable agriculture phrases and the difficulty of measurement and objective monitoring of resulting practices create confusion. These authors question: 1) whether the adoption rate for sustainable

practices will be acceptable when looking at a questionable profit motivation; 2) how effective the Cooperative Extension Service can be when trying to teach a concept that is loose and imprecise; and 3) the potential for loss of credibility by Extension when promoting reduced profit practices.

Neill Schaller (1992), writing in the same magazine, presents support for the importance of training for agents of the Cooperative Extension Service. He disputes assumptions of Hoag and Pasour and justifies the opportunity for the Cooperative Extension Service to provide agent training. The role of Extension agents, according to Schaller, should be to provide farmers with reliable facts and information on sustainable practices to help them discover, create, interpret, and wisely use, as they see fit, the best available information about sustainable agriculture. Schaller advocates additionally the role of assisting in developing farmer-to-farmer information networks, helping to coordinate farm tours and field days, and encouraging farmer input into research and educational programs as well as providing technical assistance to individual farmers.

Probably the most notable argument by Schaller in support of agent training is written with regard to the statement by Hoag and Pasour that because the concept of sustainable agriculture is "loose and imprecise" it is not something that Extension should be involved in. According to Schaller (1992):

Imagine if the Extension Service in earlier decades had followed the authors' advice to steer clear of 'loose and imprecise' subjects. I suppose it would have abstained from helping farmers decide whether and how to substitute tractors for horses and chemicals for labor. Moreover, if Extension should avoid subjects people define differently, how could one justify its educational involvement in fields such as rural community development, resource conservation, and more recently, youth at risk? (p. 33)

An investigation by Chesney (1992) into a policy study initiated as part of the Leadership Development Program of the National Center

for Food and Agricultural Policy in January, 1991, revealed perceptions that the Cooperative Extension Service still has the human resource base to maintain its competitive position in the delivery of agricultural and natural resources technology. However, the responses from county personnel differed from responses of the state personnel. County staff questioned the competitive position, citing the following hindrances: 1) competition from the private sector for workers, 2) unnecessary programs, 3) a reward and recognition system that encourages individual competition rather than teamwork, 4) a need for workers with more sophisticated skills in high technology, 5) reduction in staff due to budget cuts, and 6) a lack of training. Respondents also acknowledged that in order to be competitive Extension must provide staff with more opportunities, encouragement and training. However, many conceded that insufficient leadership and resources have been allocated to this area.

In the publication, "Alternative Agriculture," the National Research Council (1989) described the state of research and extension as follows:

U.S. agriculture has always taken pride in its ability to apply science and technology in overcoming the everyday problems of farmers. Many states, however, are losing by retirement and attrition the multidisciplinary agricultural research and education experts capable of bridging the gap between laboratory advances and practical progress on the farm. These individuals, frequently Cooperative Extension employees, have traditionally played an important role in informing research scientists of the problems faced by farmers and in integrating research advances into production programs on the farm....

The lack of support for on-farm systems research is creating a serious problem for the Cooperative Extension System. The Cooperative Extension System's ability to carry out its traditional role has eroded substantially in the last decade. This trend is likely to continue unless there are changes in research and development, educational policies, and increased financial support.... An effective alternative agricultural research program will require the participation of and improved communication among problem-solving and systems-oriented researchers, innovative farmers, farm advisers, and a larger cadre of extension specialists....

Without increased funding and a change in the intradisciplinary orientation in the tenure and promotion systems of major research universities, farming systems research and extension will remain limited, and progress toward

alternatives will be much slower than otherwise possible (National Research Council, 1989, pp. 14, 15).

According to Villanueva and Stagno (1985), possible constraints facing Extension include overemphasizing the role of the mass media, as opposed to interpersonal communications, and underestimating the effects of group characteristics or group dynamics on the decision making process.

It would seem that a continuing exchange of ideas and information, coupled with interactions among producers, researchers, specialists and extension agents, would be integral to the development of practical farm based knowledge, and crucial to any future integration of agricultural disciplines.

Sustainable Agriculture Programs of the Cooperative Extension Service

A recent study by Liebman (1992) addressed research and extension efforts for improvement of the sustainability of agriculture in the northern and northeastern areas of the United States. Much of the research and extension work presently being done deals with the reduction of production costs, as well as soil erosion and agrichemical pollution. These efforts are directed at greater use of crop rotations utilizing legumes, animal and green manures as soil builders, the integration of crop and animal production enterprises, mechanical weed control, emphasis on soil and water conservation practices, and biological pest control. Many private non-governmental organizations, according to Liebman (1992), lead the way and are providing leadership and direction in the implementation of agricultural research and extension efforts directed toward sustainability in agricultural production. Major efforts include on-farm demonstrations and research using producers as key players. The research by Liebman also indicated that many land grant colleges and universities are conducting research which emphasizes the transition away from intensive chemical usage, and the implementation of closer

ties with those producers practicing or interested in practicing low-input agriculture.

Each year the national Cooperative Extension Service receives and processes annual reports on program initiatives of the Cooperative Extension Service in each of the states. These reports focus on accomplishments of states in areas of agriculture, home economics, 4-H and youth, and rural economic development. National programs in the areas of agriculture have dealt most recently with sustainable agriculture. In the year 1992, forty-two states reported activities in areas of sustainable agriculture. In the year 1993, forty-eight states reported activities in areas of sustainable agriculture. This documentation represented the accomplishments of the Cooperative Extension Service, as reported, in areas of sustainable agriculture.

For the purpose of this study, the author selected twenty of the more interesting and innovative state sustainable agriculture reports for the year 1992, and twelve of the 1993 reports, and summarized them in short form to document some of the accomplishments of the Cooperative Extension Service in different areas of the United States with regard to training and implementation of sustainable agriculture concepts. These summaries are found in Appendices A and B.

A study of the state reports presents evidence that the Cooperative Extension Service presently is involved in many areas of sustainable agriculture. The reports from 1992, although coming in from fewer states, indicated that a large number of those states reporting were well under way with sustainable agriculture programs. This also gave strong indication of commitment to the development of this national program initiative. Several states reported a lesser amount of involvement in the development of sustainable agriculture based programs, and a number of states' reports were not received. A comparison of the 1993 reports with those of 1992 revealed heavier

program involvement in the 1993 year by most states reporting. The number of reports received also increased. Finally, many of the non-reporting states of 1992 provided extensive reports in the 1993 year, and appeared very heavily involved in sustainable agriculture.

Summary

The review of literature reveals a continuing decay of the natural resource base considered to be necessary by many authors for the survival of food production on a global basis. Phrases such as, "the potency of technologies," "the fragility of the earth's environment," "earth's limited resources," and "humankind's ability to disrupt it" (Harwood, 1990) have become more common recently. Concerns voiced many years ago are echoed today with regard to the continuing abuse and decline of our vast natural resources. In addition, voices of criticism and doubt, and those of support regarding the capabilities of the Cooperative Extension Service have been presented by researchers.

A review of literature reveals the following:

- 1) Increased support and energies directed toward the revamping of current federal agricultural environmental policies are needed.
- 2) The investigation and research into the long-term impacts of continued pesticide and fertilizer applications should be implemented.
- 3) Federal commodity support programs should be modified to include a more diversified ecological base.
- 4) The development of effective agroecological farm programs that are site specific and that incorporate the integration of agricultural disciplines should receive more emphasis by research and extension.
- 5) The Cooperative Extension Service should reassess and strengthen its position of national leadership in

agriculture programming (more specifically, areas of sustainable agriculture, and alternative production systems).

Are Cooperative Extension's agricultural agents knowledgeable, capable, and competent in the area of sustainable agriculture? Are these agents able to successfully modify and integrate sustainable agriculture production concepts into workable systems which address social and environmental concerns while providing adequate economic returns that will endure and sustain over the long term? These kinds of site-specific systems are very much needed by American farmers as well as American society. The agricultural agents of the Cooperative Extension Service have always been there for the American farmers to encourage, to motivate, and to teach. The present situation seems to be an opportunity waiting to be answered.

CHAPTER 3: PROCEDURES

The purpose of the study was to describe extension agricultural agents' perceptions of sustainable agriculture in the Southern Region of the United States. This chapter describes procedures used in conducting this descriptive study as follows: Population, Instrumentation, Validation, Data Collection, and Data Analysis.

Population

The population of this study was county/parish extension agents with primary responsibility in agriculture employed by the Cooperative Extension Service and working in the thirteen states of the Southern Region of the United States. The Southern Region is defined to include the following states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. The extension agricultural agents were either employed by thirteen institutions established by the Morrill Act of 1862 (the 1862 agencies), or by eleven institutions established by the Second Morrill Act of 1890 (the 1890 agencies).

The population included agents doing adult work and agents assigned to both adult and youth work. The population did not include Cooperative Extension agents with primary responsibility in 4-H/youth, nor did it include state specialists. Extension agents having administrative responsibilities at the district, area, or state level were excluded. Only agents working and/or assigned field work in agriculture within the thirteen states of the Southern Region of the United States were included in the target population. It is important to note that a number of counties/parishes may have more than one agent assigned with primary responsibility in agriculture. In this situation, all agents in a county/parish having agricultural responsibility were considered to be members of this population. It

is also important to note that each state in the Southern Region has at least two Cooperative Extension Services: an 1862 Cooperative Extension Service located at institutions started by the Morrill Act of 1862, and one or more 1890 Cooperative Extension Services located at institutions started by the Second Morrill Act of 1890.

Listed in Appendix C are the land grant institutions located in the thirteen states in the Southern Region of the United States. All of the State Cooperative Extension Services were invited to participate in the study. All indicated support for the study. However, three of the 1890 institutions were not included in the study due to the fact that their agricultural personnel were all para-professionals (non-degree technical staff). The administrators listed in Appendix C were the contacts for the land grant colleges and universities.

Sample

The accessible population for the study was determined using a three step process:

Step 1. Preliminary contacts were made with administrators of the land grant institutions in the thirteen states of the Southern Region of the United States. This was accomplished by sending an introductory letter which outlined the overall purpose and objectives of the study (Appendix D). In this letter, an invitation was presented to the administrator for the personnel employed with their particular Cooperative Extension Service to participate. Included was a request for a list of addresses and phone numbers of the personnel employed as agricultural agents, a copy of a rough draft of the questionnaire, and a short statement confirming support for the study (Appendix E). The administrator was afforded the opportunity to participate in the study or to decline participation. If they elected to participate in the study, they were asked to sign the

support statement and forward that along with a list of their extension agricultural agents to the researcher.

Step 2. A second contact with administrators was made shortly after sending the introductory letter, in order to elaborate more fully on the proposed study. A telephone call was made to each administrator to get firm commitment or non-commitment.

Step 3. From the personnel lists received, the researcher determined the total accessible population included 1,915 extension agricultural agents employed by twenty-four Cooperative Extension Services. Because of the possibility that agents in the 1862 institutions could differ in their perceptions of sustainable agriculture from agents in 1890 institutions, a stratified sample was utilized. Using a projected response rate of 45%, a stratified sample consisting of all 67 agents from the 1890 institutions and 345 agents from the 1862 institutions was selected. The selection of agents from the 1862 institutions was accomplished using a random sample with replacement.

Instrumentation

From the review of literature, it was determined that a research instrument that met the needs of this study was not available. The researcher developed and validated a research instrument in the form of a questionnaire to accomplish the objectives of the study. The areas of investigation emerged from the review of literature and suggestions from the validation panel. The questionnaire had six sections.

The items in Section I were used to investigate extension agriculture agents' perceptions of sustainable agriculture concepts. There were 10 statements. The respondents were asked to select a response for each statement on a Likert type scale that ranged from one (disagree) to five (agree).

The items in Section II were used to investigate extension agriculture agents' perceptions of factors and their impact on the sustainability of production agriculture during the next 10 years. There were 12 statements. Respondents were asked to indicate their perceptions of the level of impact on a Likert type scale that ranged from one (major negative impact) to five (major positive impact).

The items in Section III were used to investigate extension agricultural agents' perceptions of trends and their relationship to the future of sustainable agriculture during the next ten years. Eight statements were evaluated by the respondents using a Likert type scale with levels of agreement that ranged from one (disagree) to five (agree).

The items in Section IV were used to investigate extension agricultural agents' perceptions of the sustainable agriculture capabilities of the Cooperative Extension Service. The questionnaire provided the respondent the opportunity to agree or disagree at varying levels with seven statements that addressed agents' perceptions of Extension's ability to recommend appropriate agricultural practices. The Likert type scale ranged from one (disagree) to five (agree).

The items in Section V were used to investigate extension agricultural agents' perceptions of competencies in fifteen areas of sustainable agriculture practices. It also investigated training received in each of these areas. For the level of competence, a Likert type scale that ranged from one (not competent) to four (competent) was used. The use of a four point Likert scale eliminated the possibility of a "no opinion" response. A more definite answer was needed in order to indicate future training needs.

For the source of training, respondents were asked to indicate whether training was received in each specific area, and if so, where

that training was received. The following response categories were provided:

- 1) None received;
- 2) University/college course;
- 3) University/college workshop;
- 4) Industry workshop;
- 5) Professional conference;
- 6) Self directed learning/personal experience;
- 7) Working with producers using sustainable agriculture practices; and
- 8) On-the-job/in-service training.

Section VI was designed to secure information on the demographic characteristics of personnel employed by the Cooperative Extension Service in the Southern Region of the United States and having major responsibility in agriculture. The following demographic characteristics of respondents were investigated in this section:

- 1) Farming experience;
- 2) Agricultural area in which the major amount of professional extension time was spent;
- 3) Clientele with whom largest segment of time was spent;
- 4) Age;
- 5) Years of employment with the Cooperative Extension Service;
- 6) Highest level of educational attainment; and
- 7) Undergraduate major.
- 8) Graduate major

Instrument Validation

In order to determine the face and content validity of the questionnaire, a panel of 15 experts was identified. Each of these possessed one or more of the following attributes:

- 1) Knowledge and expertise in the area of sustainable agriculture;

- 2) Extensive agricultural background in traditional and/or low-input production systems;
- 3) Familiarity with current U.S. agricultural policies dealing with the spectrum of sustainability in agricultural systems; or
- 4) Administrative background in areas of agricultural production systems.

The backgrounds of the panel members brought diversity to the panel. Panel members represented different areas of agriculture and this diversity was valuable and pertinent to the validation process.

Contact was made with prospective panel members by telephone asking for assistance with validation of the instrument. The panel was asked to review and evaluate the questionnaire's ability to accomplish the stated objectives of the study. They were also asked to add or delete items, to make comments regarding effectiveness of the instrument, and to offer suggestions for improvement.

Of the fifteen panel members contacted, 11 agreed to take part and assist with validation of the questionnaire. A list of the members of the expert panel and their organizational affiliation may be found in Appendix F. A copy of the letter initially sent to the panel will be found in Appendix G.

A copy of the questionnaire, objectives of the study, and cover letter was mailed to each panelist. A stamped self-addressed envelope was also enclosed for easy return. Responses and suggestions were received from all of the eleven panelists. These were analyzed and used to modify the questionnaire.

Cronbach's alpha was used to determine the internal consistency of each scale in the questionnaire. Items were deleted from a scale for reporting purposes when the responses did not make a positive contribution to the variable being studied. This was done to improve the internal consistency of the scales.

The original questionnaire was printed on a 5 1/2" X 8 1/2" booklet format. The final version was modified to fit an 8 1/2" X 11" format and may be found in Appendix H.

Data Collection

Data collection was accomplished by means of a mailed questionnaire. This was sent to 412 agricultural agents employed by 24 Cooperative Extension Services in the thirteen states of the Southern Region.

On January 18, 1995, the questionnaire with a cover letter and a statement of support from each participating Extension Service's administrator, if available, along with an enclosed business reply envelope was mailed to the 412 participants. The cover letter and the statement of support are found in Appendix H, and Appendix I, respectively. Participants were requested to respond by January 25, 1995. A second mailing of the questionnaire with a revised cover letter and an enclosed business reply envelope was sent out on February 7, 1995 to those participants from whom a response had not yet been received. The revised cover letter may be found in Appendix J.

Prior to telephone follow up, there was a response rate of 92.29% and a total of 31 non-respondents. Attempts were made to contact all 31 non-respondents by phone with requests to return their completed questionnaires. If the individual was not available, a message was left with the telephone contact person. These data collection procedures resulted in the return of an additional thirteen questionnaires (41.94% of the non-respondents). A comparison by response wave was made specifically for the purpose of determining if statistically significant differences existed at the .05 level among the five scale means. The decision was made a priori that if statistically significant differences were found in fewer than two scale means, then it would be concluded that the data was

representative of the population of extension agricultural agents and the data from the phone wave would be combined with the data from the mail waves for further analyses. However, if differences were found among two or more variables, then it would be concluded that the data was not representative of the population of extension agricultural agents and the data would be disregarded. In this latter case, no inferences would be made about the population.

Statistically significant differences among response waves were found in only one of the scale means. Therefore, it was concluded that no statistically significant differences existed among the response waves and that the data collected was representative of the population of extension agricultural agents. The data collected during the phone follow-up phase was combined with the data collected by mail for further analyses.

The final response rate was 384 out of 402 or 95.52%. Of the 412 agents in the original sample, ten were determined to be frame errors because they had retired or resigned prior to the completion of the study, which resulted in a final sample size of 402. The responses by response wave are presented in Table 1. Responses by university are presented in Table K-1 (Appendix K).

Data Analysis

Objectives 1-6. Descriptive statistics (frequency distributions, means, and standard deviations) were used to analyze the data for objective one (demographic characteristics of extension agricultural agents), objective two (extension agricultural agents' perceptions of sustainable agriculture concepts), objective three (extension agricultural agents' perceptions of sustainable agriculture factors and their impact), objective four (extension agricultural agents' perceptions of sustainable agriculture trends), objective five (extension agricultural agents' perceptions of

Table 1

Response Rates by Wave

Wave	<u>n</u>	<u>%</u>
First mailing	278	69.15
Second mailing	93	23.13
Phone	13	3.24
Non-response	18	4.48
Total	402	100.00

sustainable agriculture capabilities of the Cooperative Extension Service), and objective six, (extension agricultural agents' perceptions of competencies in sustainable agriculture).

Objective 7-11. Analyses of variance (with Tukey multiple range tests when appropriate) and inferential t-tests were used to determine if differences existed in the following scale means by age, agricultural background, educational background, and type of institution of employment:

- I. Extension agricultural agents' perceptions of sustainable agriculture concepts (Objective 7)
- II. Extension agricultural agents' perceptions of factors and their potential impact on the sustainability of production agriculture (Objective 8)
- III. Extension agricultural agents' perceptions of trends and their relationship to the future of sustainable agriculture (Objective 9)

- IV. Extension agricultural agents' perceptions of capabilities of the Cooperative Extension Service in sustainable agriculture (Objective 10)
- V. Extension agricultural agents' perceptions of sustainable agriculture competencies (Objective 11)

CHAPTER 4: FINDINGS

Chapter 4 will be presented in order of the objectives of the study.

Objective 1: Demographic Characteristics of Extension Agricultural Agents Employed By the Cooperative Extension Service in the Southern Region of the United States

This objective sought to describe the demographic characteristics of personnel employed by the Cooperative Extension Service in the Southern Region of the United States and having major responsibility in agriculture. Descriptive statistics (frequency distributions, means, and standard deviations) were used to describe these characteristics (section VI of the questionnaire).

Age. The ages of the respondents ranged from 23 years to 65 years. The mean age was 41.53 years ($sd = 8.91$, $n = 378$).

Years of employment. Years of employment with the Cooperative Extension Service ranged from 1 year to 39 years. The average years of employment was 13.97 ($sd = 8.50$, $n = 381$).

Highest level of educational attainment. Over two-thirds of the respondents had completed their Master's Degree or Doctoral Degree (68.80%, $n = 264$). Those respondents with only a Bachelors Degree were less than one-third of the total number of participants (30.70%, $n = 118$). Information concerning the highest level of educational attainment of respondents is found in Table 2.

Undergraduate major. A degree was held in the animal sciences by almost one-third of the respondents (30.50%, $n = 118$). Degrees in the plant sciences were held by nearly one-fourth of the respondents (24.50%, $n = 94$). The category of "other" was selected by nearly ten percent of the respondents (8.90%, $n = 34$). Although there was an area for the respondent to indicate more specifically just what the "other" was, there were very few of the respondents that filled this

Table 2

Extension Agricultural Agents' Highest Level of Educational Attainment

Degree	<u>n</u>	<u>%</u>
Bachelors degree	118	30.70
Masters degree	251	65.40
Doctoral degree	12	3.10
Other	1	.30
Missing data	2	.50
Total	384	100.00

in. This resulted in the category "other" being very ambiguous. This also occurred with the graduate major information. Information on the undergraduate major of the respondents is found in more detail in Table 3.

Major field of study if graduate degree completed. Of those respondents who had completed a graduate degree, the greatest number (41.40%, $n = 109$) received a graduate degree in an area of education. Graduate degrees were held in the animal sciences by 52 respondents (19.80%) and in the plant sciences by 51 (19.40%). The least number of respondents (.80%, $n = 2$) held graduate degrees in wildlife/fisheries. This information is found in Table 4.

Clientele where largest segment of time was spent. When determining clientele where the major amount of time was spent by agriculture agents, the respondents had a choice of four areas: small farms (those that gross under \$50,000), moderate to large farms (all other farms), agribusinesses, and other agricultural production.

Table 3

Extension Agricultural Agents' Undergraduate Major

Major	<u>n</u>	<u>%</u>
Animal sciences	117	30.50
Plant sciences	94	24.50
Education	85	22.10
Agriculture business/economics	42	10.90
Wildlife/fisheries	5	1.30
Environmental sciences	2	.50
Other	34	8.90
Missing data	5	1.30
Total	384	100.00

Nearly one-half (47.90%, $n = 184$) indicated that most of their time was spent working with small farms. Approximately two-fifths of the respondents worked with large farms (41.10%, $n = 158$). This information is found in detail in Table 5.

Agricultural area in which the major amount of professional extension time was spent. Respondents were asked to select one of twelve response areas indicating where the major amount of their professional time was spent. Nearly one-third (32.60%, $n = 125$) of the respondents indicated that rural crop production was their major work area. Over one-fourth (25.50%, $n = 98$) indicated their major work area to be rural livestock production. Table 6 furnishes this information.

Farming experience. Respondents were asked to select all statements that described their farming experience. A respondent

Table 4

Extension Agricultural Agents' Graduate Major

Major	n	%
Education	109	41.40
Animal sciences	52	19.80
Plant sciences	51	19.40
Agriculture business/economics	19	7.20
Wildlife/fisheries	2	.80
Other	30	11.40
Total	263	100.00

Table 5

Agricultural Clientele Where Professional Time Spent

Where time spent	n	%
Small farms	184	47.90
Moderate to large farms	158	41.10
Agribusinesses	10	2.60
Other agricultural production	22	5.70
Missing data	10	2.70
Total	384	100.00

Table 6

Agricultural Area Where Major Professional Time Spent

Area	<u>n</u>	<u>%</u>
Rural crops	125	32.60
Rural livestock	98	25.50
Urban horticulture	44	11.50
Rural horticulture	26	6.80
Rural vegetable	12	3.10
Urban crops	10	2.60
Urban livestock	6	1.60
Rural timber	4	1.00
Rural non-farm	4	1.00
Urban non-farm	2	.50
Urban timber	1	.30
Other	20	5.20
Missing data	32	8.30
Total	384	100.00

could select more than one statement. The largest number of respondents (68.00%, $n = 261$) indicated that they grew up on a farm and worked on a production farm for parents. Nearly one-half (49.00%, $n = 188$) of the respondents had worked for pay on a production farm for a total of one year or longer. Over one-third (35.90%, $n = 138$) of the respondents indicated that they had operated a production farm. Table 7 gives the farming experience of the respondents.

Table 7

Extension Agricultural Agents' Farming Experience

Background	<u>n</u>	<u>t</u>
Grew up on a farm and worked on a production farm for parents	261	68.00
Worked for pay on production farm one year or longer	188	49.00
Operated a production farm	138	35.90
Never worked or lived on a production farm	36	9.40
Lived on but did not work on a production farm	4	1.00
Other agricultural experience	29	7.60
Missing data	1	.30

Note. Respondents were asked to select all statements that described their farming experience. A respondent may have selected more than one statement describing farming experience. Percentages may total more than 100% because of this.

Type of institution in which agents were employed. The type of institution in which the respondents were employed was not an item in the questionnaire. This information was determined based on the mailing list used in the study. The respondents consisted of 63 (16.40%) agents from 1890 cooperative extension services and 321 (83.60%) agents from 1862 cooperative extension services.

Objective 2: Extension Agricultural Agents' Perceptions
of Concepts of Sustainable Agriculture in the Southern
Region of the United States

Descriptive statistics (frequency distributions, means, and standard deviations) were used to describe respondents' perceptions of sustainable agriculture concepts (see this section of the questionnaire on page 152). Analysis of internal consistency (using

Cronbach's alpha) was used to determine which items were the strongest positive contributors to the scale in Section I and as a data reduction technique. This identified eight items which measured agents' perceptions of sustainable agriculture. Items g. and j. (see this section of questionnaire on page 152) were negative contributors to the internal consistency of the scale; therefore they were omitted from the scale. The overall reliability for the scale as measured by Cronbach's alpha using the eight items was .71.

The scale used to interpret the means of agents' perceptions of sustainable agriculture concepts follows:

- 1.0 to 1.50 = disagree
- 1.51 to 2.50 = slightly disagree
- 2.51 to 3.50 = no opinion
- 3.51 to 4.50 = slightly agree
- 4.51 to 5.00 = agree

Respondents perceived that sustainable agriculture practices can be successfully used in production systems (\bar{m} = 4.01) and that perennial grain crops should receive more research emphasis (\bar{m} = 3.84). They did not perceive that chemical residues on fruits and vegetables in the marketplace pose a significant health threat to the consumer (\bar{m} = 1.76); major outbreaks of insects can be controlled without the use of chemical insecticides (\bar{m} = 1.75); most crop disease organisms can be controlled without the use of fungicides (\bar{m} = 1.86); and weed control in most cropping systems can be accomplished economically without herbicides (\bar{m} = 2.01). These data are presented in Table 8.

Objective 3: Extension Agricultural Agents' Perceptions of Factors and Their Potential Impact On The Sustainability Of Production Agriculture in the Southern Region of the United States

Twelve factors (Section II of the questionnaire) were used to investigate respondents' perceptions of factors and their potential impact on the sustainability of production agriculture during the

Table 8

Extension Agricultural Agents' Perceptions of Sustainable Agriculture Concepts

Statement	<u>m</u>	<u>sd</u>
Federal guidelines for acceptable levels of pesticides and other polluting agents found in municipal drinking water systems should be relaxed. (not used in scale)	4.07	1.08
Most sustainable agriculture practices can be successfully used in production systems.	4.01	1.03
Perennial grain crops, with the potential for sustaining or increasing production with limited inputs, should receive more research emphasis.	3.84	1.01
The use of organic pest control methods would greatly reduce pesticides and contribute to the reduction of non-point source pollution.	3.46	1.19
A sustainable production system using crop rotation, green manure crops, and animal manures can be economically comparable to a conventional system that uses synthetic fertilizers.	3.14	1.36
Many sustainable agriculture practices that may be successfully adopted in other states are not economically feasible in this state. (not used in scale)	2.80	1.26
Weed control in most cropping systems can be accomplished economically without the use of herbicides.	2.01	1.16
Most crop disease organisms can be successfully controlled without the use of fungicides.	1.86	1.06
Chemical residues on many fruits and vegetables that are currently available in the marketplace pose a significant health threat to the consumer.	1.76	1.13
Major outbreaks of insects can be controlled without the use of chemical insecticides.	1.75	1.07

Note. 1.00 to 1.50 = disagree, 1.51 to 2.50 = slightly disagree, 2.51 to 3.50 = no opinion, 3.51 to 4.50 = slightly agree, 4.51 to 5.00 = agree.

next ten years. An analysis of internal consistency (using Cronbach's alpha) was used to determine which of the 12 items were the strongest positive contributors to the scale in Section II and as a data reduction technique. This revealed that all 12 items were positive contributors. Overall reliability for this scale as measured by Cronbach's alpha was .84.

The scale used to interpret the means of agents' perceptions of the impact of factors on the sustainability of production agriculture follows:

- 1.0 to 1.50 = major negative impact
- 1.51 to 2.50 = negative impact
- 2.51 to 3.50 = no impact
- 3.51 to 4.50 = positive impact
- 4.51 to 5.00 = major positive impact

The data in Table 9 revealed that the respondents perceived that the Cooperative Extension Service (\bar{m} = 4.28) and minimum tillage systems (\bar{m} = 4.03) would have a positive impact on the sustainability of production agriculture during the next ten years. The remaining factors were perceived to have either a negative impact or no impact. These data are found in detail in Table 9.

Objective 4: Extension Agricultural Agents' Perceptions of Trends and Their Relationship to the Future of Sustainable Agriculture in the Southern Region of the United States

The agents were asked their perceptions of eight trends and their potential relationship to the future of sustainable agriculture during the next ten years. Analysis of internal consistency (using Cronbach's alpha) was used to determine which of the eight items were the strongest positive contributors to the scale in Section III and as a data reduction technique. This revealed that seven of the eight items were positive contributors to the measurement of these trends. Item c. (see page 154) was a negative contributor to the internal consistency of the scale; therefore it was omitted from the

Table 9

Extension Agricultural Agents' Perceptions of Factors and Their Potential Impact on the Sustainability of Production Agriculture

Factor	<u>m</u>	<u>sd</u>
The Cooperative Extension Service	4.28	.79
Minimum tillage systems	4.03	.67
Modification of federal farm commodity support systems toward a more ecological base	3.15	1.01
Global warming	2.62	.79
Significant shortage of synthetic fertilizers	2.35	1.14
Salinization of water	2.35	.92
Increased nitrate levels in drinking and in irrigation water	2.27	.96
Increased utilization of marginal soils that are highly susceptible to erosion	2.26	1.01
Increased pesticide residues in groundwater	2.15	1.06
Reduced water availability	2.08	1.07
Severe erosion of major crop land	2.06	1.09
Loss of productive lands to population expansion	2.03	1.03

Note. 1.00 to 1.50 = major negative impact, 1.51 to 2.50 = negative impact, 2.51 to 3.50 = no impact, 3.51 to 4.50 = positive impact, 4.51 to 5.00 = major positive impact.

scale. The overall reliability for this scale using these seven items as measured by Cronbach's alpha was .84.

The scale used to interpret the means of agents' perceptions of trends and their relationship to the future of sustainable agriculture follows:

- 1.0 to 1.50 = disagree
- 1.51 to 2.50 = slightly disagree
- 2.51 to 3.50 = no opinion
- 3.51 to 4.50 = slightly agree
- 4.51 to 5.00 = agree

Respondents did not perceive that cultural and biological control methods will replace chemical pest control methods in most major agricultural production systems within the next ten years (\bar{m} = 2.41). They perceived that large irrigation systems would adopt practices that significantly reduced water usage (\bar{m} = 3.98). These data are presented in Table 10.

Objective 5: Extension Agricultural Agents' Perceptions of Sustainable Agriculture Capabilities of the Cooperative Extension Service in the Southern Region of the United States

Descriptive statistics (frequency distributions, means, and standard deviations) were used to describe agents' perceptions of the sustainable agriculture capabilities of the Cooperative Extension Service (Section IV of the questionnaire). Seven statements concerning the capabilities of the Cooperative Extension Service in areas of sustainable agriculture were presented. Analysis of internal consistency (using Cronbach's alpha) was used to determine which of the seven items were the strongest positive contributors to the scale in Section IV and as a data reduction technique. This analysis identified six items from the seven items which effectively measured agents' perceptions of the capabilities of the Cooperative Extension Service. Item e. (see this section of the questionnaire on page 157) was a negative contributor to the internal consistency of the scale; therefore it was omitted from the scale. The reliability for the scale using the six items was .61 as measured by Cronbach's alpha.

Table 10

Extension Agricultural Agents' Perceptions of Trends and Their Relationship to the Future of Sustainable Agriculture in the Southern Region of the United States

Trend	<u>m</u>	<u>sd</u>
Large irrigation systems will adopt practices that significantly reduce water usage	3.98	1.04
Waste products from large animal production systems will continue to create significant environmental problems.	3.09	1.35
Salinization of water will pose a serious threat to the irrigation and drinking water systems within ten years	3.01	1.15
There will be a large scale reduction in the use of pesticides and synthetic fertilizers	2.79	1.26
The potential loss of genetic diversity in plant varieties through production systems utilizing hybrids presents the possibility of future devastation of major crops by insects or diseases	2.66	1.30
There will be a substantial return to dryland farming in the next ten years	2.65	1.13
If large farms change their production methods from using heavy inputs of pesticides and synthetic fertilizers to using low-input sustainable methods, this change will create an inability to produce large enough crop yields to support a growing population (Not used in scale)	2.62	1.29
Cultural and biological control methods will replace chemical pest control methods in most major agricultural production systems within ten years	2.41	1.26

Note. 1.00 to 1.50 = disagree, 1.51 to 2.50 = slightly disagree, 2.51 to 3.50 = no opinion, 3.51 to 4.50 = slightly agree, 4.51 to 5.00 = agree.

The scale used to interpret the means of agents' perceptions of capabilities in sustainable agriculture of the Cooperative Extension Service follows:

- 1.0 to 1.50 = disagree
- 1.51 to 2.50 = slightly disagree
- 2.51 to 3.50 = no opinion
- 3.51 to 4.50 = slightly agree
- 4.51 to 5.00 = agree

Respondents perceived that the Cooperative Extension Service provided the major leadership in areas of sustainable agriculture in their county/parish (\bar{m} = 4.06). They also perceived that more time and adequate funding should be set aside for training in sustainable agriculture technology (\bar{m} = 4.11). This information is presented in Table 11.

Objective 6: Extension Agricultural Agents' Perceptions of Competencies in Sustainable Agriculture in the Southern Region of the United States

Descriptive statistics (frequency distributions, means, and standard deviations) were used to describe extension agricultural agents' perceptions of sustainable agriculture competencies (section V of the questionnaire). Respondents were asked to indicate their perceived level of competence in fifteen areas of sustainable agriculture. Competent is defined as capable, fit, or qualified.

In addition to investigating the perceived competencies, respondents were also provided an opportunity to indicate sources of training for the competence areas of sustainable agriculture. Eight sources of training were provided beside each area of competence. Respondents were asked to select all sources of training that applied to each area of competence. Table 12 presents each of the fifteen areas of competence. In Table 13, the sources of training are shown for each area of competence.

Table 11

Extension Agricultural Agents' Perceptions of Capabilities of the Cooperative Extension Service in Sustainable Agriculture

Statement	m	sd
More time and adequate funding should be set aside for training in the area of sustainable agriculture	4.11	.94
The Cooperative Extension Service provides the major leadership in areas of sustainable agriculture technology in my county/parish	4.06	1.07
Personnel presently assigned to sustainable agricultural program areas have the needed expertise to teach specific agricultural concepts utilizing sustainable production methods	3.29	1.12
All agricultural production methods that are being taught and promoted by the Cooperative Extension Service are conducive to the sustainability of agricultural production.	3.29	1.31
The Cooperative Extension Service can provide the continuing needed sustainable agriculture teaching services with present capabilities.	3.07	1.33
Changes are needed in the qualifications required for newly hired agricultural extension agents to include sustainable agriculture training or competence. (not used in scale)	3.02	1.29
The Cooperative Extension Service has provided adequate training for agricultural agents in areas of sustainable agriculture technology.	2.80	1.30

Note. 1.00 to 1.50 = disagree, 1.51 to 2.50 = slightly disagree, 2.51 to 3.50 = no opinion, 3.51 to 4.50 = slightly agree, 4.51 to 5.00 = agree.

An analysis of internal consistency was used to determine which of the competency items were the strongest contributors to the scale. This revealed that all items were positive contributors to the scale. The reliability for the scale as measured by Cronbach's alpha was

.90. It was not appropriate to calculate the reliability of the sources of training scale.

A Likert type scale offered competence levels from one to four as follows:

- 1.0 to 1.5 = not competent
- 1.51 to 2.50 = slightly competent
- 2.51 to 3.50 = moderately competent
- 3.51 to 4.0 = competent

With the means of all perceived competency areas ranging between a low of 1.72 (sd = .86) in the area of competency in computer software dealing with sustainable agriculture and a high of 2.82 (sd = .910) in the area of minimum tillage production systems, the respondents perceived themselves to be either slightly competent or moderately competent in all areas of sustainable agriculture under investigation. The respondents perceived themselves to be slightly competent in the use of trap crops, the use of cover crops in orchards, ridge tillage systems, and the use of computer software. They perceived themselves to be moderately competent in biological pest control methods, minimum tillage systems, and weed management. This information is found in Table 12.

Investigation into training received by agents in the competence areas revealed that over half (51%, n = 194) indicated that they had received no training in the area of computer software dealing with sustainable agriculture topics. Respondents perceived themselves to be less competent in this area of competency (m = 1.72) than all others investigated.

Over 90% of the respondents indicated that they had received some training in the areas of minimum tillage production systems (92%, n = 354), and soil nutrient management and fertilization methods (91%, n = 351). Respondents also perceived themselves to be more competent in these areas than the other competencies investigated (Table 13).

Table 12

Extension Agricultural Agents' Perceptions of Competencies in Areas of Sustainable Agriculture

Area of competence	<u>m</u>	<u>sd</u>	<u>n</u>
Minimum tillage production systems	2.82	.91	374
Soil nutrient management and fertilization methods in sustainable agriculture systems	2.78	.92	380
Rotational systems in agronomic crops for sustainable agriculture production	2.77	.94	376
Rotational livestock grazing systems for sustainable agriculture production	2.76	1.06	376
No-till production systems	2.69	.96	374
Weed management in sustainable agriculture systems	2.65	.87	378
The use of cover crops in sustainable vegetable production systems	2.54	.98	377
Biological pest control methods in sustainable production systems	2.52	.83	380
Solid waste product utilization in sustainable agriculture systems	2.46	.92	378
Interplantings, cover crops, and green manure utilization in sustainable agricultural systems	2.42	.89	378
The integration of animal and plant systems in sustainable agriculture systems	2.40	.97	377
The use of cover crops in sustainable orchard production systems	2.07	1.02	376
The use of trap crops in sustainable production systems	2.05	.86	379
Ridge tillage production systems	1.94	.95	368
The use of computer software dealing with sustainable agriculture topics	1.72	.86	362

Note. 1.00 to 1.50 = not competent, 1.51 to 2.50 = slightly competent, 2.51 to 3.50 = moderately competent, 3.51 to 4.00 = competent.

Table 13

Training Received By Extension Agricultural Agents in Competency Areas of Sustainable Agriculture

Area of competence	Type of training received (see Note)							
	1	2	3	4	5	6	7	8
	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>
Biological pest control methods in sustainable production systems	54/14	101/26	104/27	49/13	106/28	173/45	137/36	234/61
The use of trap crops in sustainable production systems	110/29	61/16	67/17	19/5	62/16	90/23	58/15	155/40
The use of cover crops in sustainable vegetable production systems	71/19	93/24	88/23	32/8	76/20	150/39	106/28	195/51
The use of cover crops in sustainable orchard production systems	139/36	44/12	65/17	19/5	49/13	92/24	70/18	147/38
Minimum tillage production systems	30/8	97/25	115/30	61/16	110/29	162/42	168/44	239/62
No-till production systems	41/11	96/25	105/27	53/14	96/25	148/39	148/39	224/58
Ridge tillage production systems	150/39	46/12	56/15	22/6	40/10	77/20	58/15	113/29
Weed management in sustainable agricultural systems	49/13	92/24	114/30	53/14	100/26	155/40	139/36	230/60
Solid waste product utilization in sustainable agriculture systems	59/16	45/12	97/25	34/9	79/21	137/36	119/31	221/58

(table continues)

Area of competence	<u>Type of training received</u> (see Note)							
	1	2	3	4	5	6	7	8
	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>	<u>n/t</u>
Soil nutrient management and fertilization methods in sustainable agricultural systems	33/9	110/29	118/31	43/11	106/28	169/44	141/37	253/66
Interplantings, cover crops, and green manure utilization in sustainable agriculture systems	69/18	81/21	81/21	26/7	66/17	143/37	106/28	201/52
Rotational systems in agronomic crops for sustainable agriculture production	47/12	123/32	109/28	38/10	86/22	167/44	152/40	232/60
Rotational livestock grazing systems for sustainable agricultural production	60/16	103/27	115/30	52/14	98/26	165/43	160/42	233/61
The integration of animal and plant systems in sustainable agriculture systems	88/23	79/21	91/24	32/8	65/17	138/36	105/27	191/50
The use of computer software dealing with sustainable agricultural topics	194/51	39/10	56/15	14/4	42/11	73/19	35/9	114/30

(table continues)

NOTE. TRAINING RECEIVED:

- 1 = None received
- 2 = University/college course
- 3 = University/college workshop
- 4 = Industry workshop
- 5 = Professional conference
- 6 = Self-directed learning/personal experience
- 7 = Working with producers using sustainable agriculture practices
- 8 = On-the-job/in-service training

Because respondents may have selected more than one choice of training source, percentages may total more than 100%.

Objective 7: Differences in Extension Agricultural Agents' Perceptions of Sustainable Agriculture Concepts by Age, Agricultural Background, Educational Background, and Type of Institution of Employment

Objective seven was to determine if differences existed in the perceptions of respondents towards sustainable agriculture concepts by selected variables. This objective investigated the treatment of the dependent variable "perception" by the independent variables. The independent variables were age, agricultural background, educational background, and type of institution of employment. Analyses of variance and t -tests were used to determine if differences existed.

Differences by age. For the purpose of the study, agents were arbitrarily divided into four age groups:

- Group 1 (33 years and younger)
- Group 2 (34 years through 43 years)
- Group 3 (44 years through 53 years)
- Group 4 (54 years and over)

Using the Tukey multiple range test, it was found that statistically significant differences existed. Respondents of age 33 years and younger were significantly more likely to agree with the sustainable agriculture concepts than those respondents 34 years and older. Table 14 has this information.

Differences by clientele group (Size of farm or agribusiness).

The variable clientele was broken into the following three groups for the investigation of differences by clientele groups:

- Group 1 (small farms below \$50,000 gross income)
- Group 2 (moderate to large farms)
- Group 3 (agribusinesses)

It should be noted that the fourth category in the questionnaire, other agricultural production, was not used in the analyses of variance for objectives seven through eleven because this item was an

open ended item. As a result, it was not appropriate to use this variable in the analyses.

Analysis of variance showed that statistically significant differences existed and that the respondents who worked with small farm clientele were significantly more likely to agree ($m = 2.78$) with the concepts presented than were the respondents who worked primarily with moderate to large farm clientele ($m = 2.58$). This is summarized in Table 14.

Differences by technical area where major amount of time was spent. To investigate respondents differences by the technical area where the major amount of professional time was spent, several areas were arbitrarily arranged to form three major technical areas:

Area 1 (rural plant science) was composed of respondents indicating that their major work area was rural agronomic crop production, rural horticulture, rural vegetable production, and rural tree/timber production. Area 2 (urban plant science) was composed of respondents indicating that their major work area was urban/suburban agronomic crop production, urban/suburban horticulture, urban/suburban vegetable production, and urban/suburban tree/timber production. Area 3 (rural animal science) was composed of respondents who indicated that their major work area was rural livestock production. Analysis of variance showed no statistically significant differences in agent perceptions by technical area. This is summarized in Table 14.

Differences by undergraduate major. Respondents' perceptions of sustainable agriculture concepts were analyzed by undergraduate major. The responses were grouped into four categories (the other areas were dropped because of lack of adequate cell size for use in the analysis of variance). The categories were:

Table 14

Analyses of Variance of Extension Agricultural Agents' Perceptions of Sustainable Agriculture Concepts By Age, Agricultural Background, and Educational Background

Source of variation	SS	df	MS	Sig F
Age of respondents				
Regression	5.26	3	1.75	.00
Residual	86.26	362	.24	
Total	91.52	365		
<p>Statistically significant differences were found among groups at the .05 level. The bars connect the means that were not significantly different from each other.</p>				
33 or less $\bar{m} = 2.91$	34 - 43 yrs. $\bar{m} = 2.63$	44 - 53 yrs. $\bar{m} = 2.62$	54 and over $\bar{m} = 2.60$	
Agricultural farm clientele				
Regression	3.73	2	1.86	.00
Residual	80.45	337	.24	
Total	84.18	339		
<p>Statistically significant differences were found among groups at the .05 level. The bars connect the means that were not significantly different from each other.</p>				
Small farms $\bar{m} = 2.78$	Moderate to large farms $\bar{m} = 2.58$	Agribusinesses $\bar{m} = 2.47$		
Technical area in which major amount of professional Extension time spent				
Regression	.23	2	.12	.61
Residual	71.06	309	.23	
Total	71.29	311		
Agricultural discipline (Undergraduate major)				
Regression	.62	3	.21	.46
Residual	77.29	325	.24	
Total	77.91	328		

(table continues)

Source of variation	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>Sig F</u>
Agricultural discipline (graduate major)				
Regression	.84	3	.28	.30
Residual	49.87	219	.23	
Total	50.71	222		

Area 1 education (agricultural, extension, adult, etc.)

Area 2 animal science (poultry science, dairy science, veterinary science, etc.)

Area 3 plant science (agronomy, horticulture, floriculture, forestry, etc.)

Area 4 agricultural business and /or economics.

Analysis of variance was performed by undergraduate major. No statistically significant differences were found (Table 14).

Differences by graduate major. Respondents' perceptions of sustainable agriculture concepts were analyzed by graduate major. The responses were grouped into the same categories as the analysis by undergraduate major (see previous section). Analysis of variance did not show any statistically significant differences in perception by graduate major. This is summarized in Table 14.

Differences by farm background. For the purpose of the study, farm background was broken into two major groups:

Group 1 (respondents who had no farm background)

Group 2 (respondents who had a farm background).

The following categories were combined into Group 1: those respondents who never worked on nor lived on a production farm, and those who lived on but did not work on a production farm. Group 2 was a combination of the following: those who had worked for pay on a production farm for a total of one year or longer; those who grew

up on a farm and worked on a production farm for parents; and those who operated a production farm.

The t -test showed no statistically significant difference between group perceptions of sustainable agriculture concepts. Results are found in Table 15.

Table 15

Differences in Extension Agricultural Agents' Perceptions of Sustainable Agriculture Concepts By Farm Background

Variable	<u>n</u>	<u>m</u>	<u>sd</u>	<u>t</u>
No farm background	56	2.71	.53	.777
Farm background	316	2.69	.50	

Differences by type of institution of employment (1862 Extension Service, 1890 Extension Service). Differences in extension agricultural agents' perceptions of sustainable agriculture concepts by type of institution of employment were investigated using the t -test. Statistically significant differences were found in perceptions of sustainable agriculture concepts between those agents working for 1862 Extension Services and those agents working for 1890 Extension Services. The 1890 agents were found to be more likely ($m = 2.99$) to agree with the concepts presented in the questionnaire than were the 1862 agents ($m = 2.63$). Results are found in Table 16.

Objective 8: Differences in Extension Agricultural Agents' Perceptions of The Potential Impact of Factors on The Sustainability of Production Agriculture by Age, Agricultural Background, Educational Background, and Type of Institution of Employment

Objective eight was to determine if differences existed in the perceptions of respondents toward the potential impact of factors on the sustainability of production agriculture by selected variables.

Table 16

Differences in Extension Agricultural Agents' Perceptions of Sustainable Agriculture Concepts By Type of Institution of Employment

Variable	n	m	SD	t
1862 agents	311	2.63	.45	.00*
1890 agents	61	2.99	.62	
Statistically significant differences were found between groups at the .05 level				

* $p < .05$

The variables were age, agricultural background, educational background, and type of institution of employment. Analyses of variance and t -tests were used to determine if these differences existed.

Investigation of the differences in perceptions of respondents by age towards factors and their potential impact on the sustainability of production agriculture indicated no statistically significant differences among age groups. Neither were differences found when investigating technical area in which a majority of professional time was spent, clientele (farm size), or graduate major. There were statistically significant differences found among respondents when investigating differences by undergraduate major. The group with an undergraduate degree in agricultural business and/or economics ($m = 2.86$) was more likely to perceive statements regarding the impact of factors to have potential for positive impact than were the groups with an undergraduate degree in animal science ($m = 2.59$) or plant science ($m = 2.55$). This information is found in Table 17.

Investigations of differences in respondents' perceptions of the potential impact of factors by farm or non-farm background, and by

Table 17

Analyses of Variance of Extension Agricultural Agents' Perceptions of The Potential Impact of Factors On the Sustainability of Production Agriculture By Age, Agricultural Background, and Educational Background

Source of variation	SS	df	MS	Sig F
Age of respondents				
Regression	1.97	3	.66	.08
Residual	103.46	344	.30	
Total	105.43	347		
Technical area in which major amount of professional Extension time is spent				
Regression	1.23	2	.62	.12
Residual	82.98	292	.28	
Total	82.21	294		
Agricultural farm clientele				
Regression	.04	2	.02	.93
Residual	101.85	322	.32	
Total	101.89	324		
Agricultural discipline (Undergraduate major)				
Regression	3.93	3	1.31	.00
Residual	86.99	307	.28	
Total	90.93	310		
<p>Statistically significant differences were found among groups at the .05 level. The bars connect the means that were not significantly different from each other.</p>				
<p>Agricultural business/economics Education Animal science Plant science</p> <p>$\bar{m} = 2.86$ $\bar{m} = 2.76$ $\bar{m} = 2.59$ $\bar{m} = 2.55$</p>				
Agricultural discipline (graduate major)				
Regression	1.03	3	.35	.30
Residual	57.47	209	.28	
Total	58.50	212		

type of institution of employment were performed using t-tests. No statistically significant differences were found between the groups by farm or non-farm background. This information is found in Table 18. When investigating differences by 1862 or 1890 Extension Services, there were no statistically significant differences found. This is found in Table 19.

Table 18

Differences in Extension Agricultural Agents' Perceptions of The Potential Impact of Factors On the Sustainability of Production Agriculture By Farm Background

Variable	<u>n</u>	<u>m</u>	<u>sd</u>	<u>t</u>
No farm background	57	2.59	.49	.247
Farm background	297	2.69	.57	

Table 19

Differences in Extension Agricultural Agents' Perceptions of The Potential Impact of Factors On the Sustainability of Production Agriculture By Type of Institution of Employment

Variable	<u>n</u>	<u>m</u>	<u>SD</u>	<u>t</u>
1862 Agents	296	2.65	.51	.09
1890 Agents	58	2.78	.75	

Objective 9: Differences in Extension Agricultural Agents' Perceptions of Trends and Their Relationship to the Future of Sustainable Agriculture By Age, Agricultural Background, Educational Background, and Type of Institution of Employment

The purpose of this objective was to determine if differences existed in the perceptions of respondents toward trends and their relationship to the future of sustainable agriculture by selected variables. The variables were age, agricultural background, educational background, and type of institution of employment.

Analyses of variance of perceptions of trends and their relationship to the future of sustainable agriculture by age, technical area where major amount of professional time was spent, clientele by farm size, undergraduate major, and graduate major were conducted. No statistically significant differences were found among any groups other than clientele by farm size. Respondents working with small farm clientele were more inclined to agree with statements regarding trends ($\bar{m} = 3.06$) and their relationship to the future of sustainable agriculture than were those respondents working with agribusinesses ($\bar{m} = 2.60$). This information is found in Table 20.

Investigation of differences in agents' perceptions of trends and their relationship to the future of sustainable agriculture by farm or non-farm background, and by type of institution of employment was performed using t -tests. No statistically significant differences were found between the groups divided by farm or non-farm background. This information is found in Table 21.

When investigating differences by 1862 or 1890 Extension Services, there were statistically significant differences found between the two groups. The respondents working for the 1890 Extension Services ($\bar{m} = 3.26$) were found to be more likely to agree with trends as presented in the questionnaire than were the respondents with the 1862 Extension Services ($\bar{m} = 2.95$). This information is found in Table 22.

Objective 10: Differences in Extension Agricultural Agents' Perceptions of Capabilities of the Cooperative Extension Service in Sustainable Agriculture By Age, Agricultural Background, Educational Background, and Type of Institution of Employment

Objective ten was to determine if differences existed in the perceptions of respondents toward the capabilities of the Cooperative Extension Service in sustainable agriculture by selected variables. The variables were age, agricultural background, educational background, and type of institution of employment. Analyses of

Table 20

Analyses of Variance of Extension Agricultural Agents' Perceptions of Trends and Their Relationship to the Future of Sustainable Agriculture By Age, Agricultural Background, and Educational Background

Source of variation	SS	df	MS	Sig. F
Age of respondents				
Regression	.11	3	.04	.95
Residual	117.49	368	.32	
Total	117.59	371		
Technical area in which major amount of professional Extension time is spent				
Regression	.17	2	.09	.77
Residual	102.13	313	.33	
Total	102.30	315		
Agricultural farm clientele				
Regression	2.62	2	1.31	.02
Residual	109.29	344	.32	
Total	111.92	346		
Statistically significant differences were found among groups at the .05 level. The bars connect the means that were not significantly different from each other.				
Small farms $\bar{m} = 3.06$	Moderate to large farms $\bar{m} = 2.94$	Agribusinesses $\bar{m} = 2.60$		
Agricultural discipline (Undergraduate major)				
Regression	.21	3	.07	.89
Residual	109.42	330	.33	
Total	109.63	333		
Agricultural discipline (graduate major)				
Regression	.87	3	.29	.49
Residual	81.75	225	.36	
Total	82.62	228		

Table 21

Differences in Extension Agricultural Agents' Perceptions of Trends and Their Relationship to the Future of Sustainable Agriculture By Farm Background

Variable	<u>n</u>	<u>m</u>	<u>SD</u>	<u>t</u>
No farm background	60	3.06	.58	.34
Farm background	318	2.99	.57	

Table 22

Differences in Extension Agricultural Agents' Perceptions of Trends and Their Relationship to the Future of Sustainable Agriculture By Type of Institution of Employment

Variable	<u>n</u>	<u>m</u>	<u>sd</u>	<u>t</u>
1862 Agents	319	2.95	.53	.00*
1890 Agents	59	3.26	.70	

Statistically significant differences were found between groups at the .05 level

* $p < .05$

variance and t-tests were used to determine if these differences existed.

Analyses of variance by the selected variables indicated that there were no statistically significant differences in perceptions of the capabilities of the Cooperative Extension Service in sustainable agriculture by age and technological area where major time was spent. There were differences in perceptions by clientele group, undergraduate major, and graduate major. It was found that the respondents who worked with small farm clientele were more likely to

agree with Extension's sustainable agriculture capabilities ($\bar{m} = 3.52$) than were the other two groups. Respondents working with agribusinesses were found to be more likely to disagree ($\bar{m} = 2.71$) with the capabilities of the Cooperative Extension Service in sustainable agriculture than the other two groups. When investigating perceptions of sustainable agriculture capabilities by undergraduate major, it was found that those respondents with undergraduate degrees in the area of plant science ($\bar{m} = 3.15$) were less likely to agree with the capabilities of the Cooperative Extension Service in sustainable agriculture than were the other three groups. Respondents with graduate degrees in the area of plant science ($\bar{m} = 3.10$) were also less likely to agree with the capabilities of the Cooperative Extension Service in sustainable agriculture than were the respondents with graduate degrees in animal science ($\bar{m} = 3.49$) or in education ($\bar{m} = 3.44$). Table 23 has this information.

Investigations of differences in agents' perceptions of the sustainable agriculture capabilities of the Cooperative Extension Service by farm or non-farm background, and by type of institution of employment were performed using t -tests. Statistically significant differences were found between the groups divided by farm or non-farm background. Those respondents with farm background ($\bar{m} = 3.41$) were found to be more likely to agree with the capabilities of the Cooperative Extension Service in sustainable agriculture than respondents who had no farm background ($\bar{m} = 3.20$). This information is found in Table 24.

When investigating differences in agents' perceptions by 1862 or 1890 Extension Services, there were statistically significant differences found between the two groups. The respondents working for the 1890 Extension Services ($\bar{m} = 3.63$) were found to be more likely to agree with capabilities of the Cooperative Extension

Table 23

Analyses of Variance of Extension Agricultural Agents' Perceptions of Capabilities of the Cooperative Extension Service in Sustainable Agriculture By Age, Agricultural Background, and Educational Background

Source of variation	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>Sig F</u>
Age of respondents				
Regression	1.50	3	.50	.28
Residual	144.83	372	.39	
Total	146.34	375		

Technical area in which major amount of professional Extension time is spent

Regression	1.71	2	.86	.11
Residual	120.31	315	.38	
Total	122.02	317		

Agricultural farm clientele

Regression	8.48	2	4.24	.00
Residual	136.36	348	.39	
Total	144.84	350		

Statistically significant differences were found among groups at the .05 level. All three means were significantly different from each other.

Small farms	Moderate to large farms	Agribusinesses
$\bar{m} = 3.52$	$\bar{m} = 3.31$	$\bar{m} = 2.71$

Agricultural discipline (undergraduate major)

Regression	7.21	3	2.40	.00
Residual	129.62	333	.39	
Total	136.82	336		

Statistically significant differences were found among groups at the .05 level. The bars connect the means that were not significantly different from each other.

	Agricultural business/		
Education	economics	Animal science	Plant science
$\bar{m} = 3.50$	$\bar{m} = 3.49$	$\bar{m} = 3.43$	$\bar{m} = 3.15$

(table continues)

Source of variation	SS	df	MS	Sig F
Agricultural discipline (graduate major)				
Regression	5.00	3	1.66	.00
Residual	90.74	225	.40	
Total	95.74	228		

Statistically significant differences were found among groups at the .05 level. The bars connect the means that were not significantly different from each other.

Animal science	Education	Agricultural business/ economics	Plant science
$\bar{m} = 3.49$	$\bar{m} = 3.44$	$\bar{m} = 3.29$	$\bar{m} = 3.10$

Table 24

Differences in Extension Agricultural Agents' Perceptions of Capabilities of the Cooperative Extension Service in Sustainable Agriculture By Farm Background

Variable	n	\bar{m}	sd	t
No farm background	61	3.20	.58	.01*
Farm background	321	3.41	.64	

Statistically significant differences were found between groups at the .05 level

*p < .05

Service in sustainable agriculture than were the respondents employed by the 1862 Extension Services ($\bar{m} = 3.32$). Table 25 has this information.

Table 25

Differences in Extension Agricultural Agents' Perceptions of Capabilities of the Cooperative Extension Service in Sustainable Agriculture By Type of Institution of Employment

Variable	n	m	sd	t
1862 agents	319	3.33	.60	.00*
1890 agents	63	3.63	.73	
Statistically significant differences were found between groups at the .05 level				

* $p < .05$

Objective 11: Differences in Extension Agricultural Agents' Perceptions of Competencies in Sustainable Agriculture By Age, Agricultural Background, Educational Background, and Type of Institution of Employment

Objective eleven was to determine if differences existed in agents' perceptions of competencies in sustainable agriculture by selected variables. The variables were age, agricultural background, educational background, and type of institution of employment. Analyses of variance and t -tests were used to determine if differences existed.

When investigating the variables age, agricultural farm clientele, undergraduate major, and graduate major, no statistically significant differences were found. There were statistically significant differences by technical area in which major amount of professional time was spent. Respondents who worked predominantly in a rural technical area of plant science or animal science perceived themselves to be more competent in sustainable agriculture than respondents working in an urban technical area of plant science. Table 26 has this information.

Investigations of differences in perceptions of the competencies of respondents in sustainable agriculture by farm or non-farm

Table 26

Analyses of Variance of Extension Agriculture Agents' Perceptions of Competencies in Sustainable Agriculture By Age, Agricultural Background, and Educational Background

Source of variation	SS	df	MS	Sig F
Age of respondents				
Regression	1.24	3	.41	.33
Residual	114.36	320	.36	
Total	115.60	323		
Technical area in which major amount of professional Extension time is spent				
Regression	3.13	2	1.57	.00*
Residual	86.86	275	.32	
Total	89.99	277		
Statistically significant differences were found among groups at the .05 level. The bars connect the means that were not significantly different from each other.				
Plant science (rural) $\bar{m} = 2.54$	Animal science (rural) $\bar{m} = 2.44$	Plant science (urban) $\bar{m} = 2.23$		
Agricultural farm clientele				
Regression	.68	2	.34	.37
Residual	103.33	301	.34	
Total	104.02	303		
Agricultural discipline (undergraduate major)				
Regression	.28	3	.09	.85
Residual	98.16	286	.34	
Total	98.44	289		
Agricultural discipline (graduate major)				
Regression	.43	3	.14	.75
Residual	66.63	190	.35	
Total	67.06	193		

* $p < .05$

background and by type of institution of employment were performed using t -tests. Statistically significant differences were found between the groups divided by farm or non-farm background.

Respondents with farm background ($\bar{m} = 2.52$) perceived themselves to be more competent in sustainable agriculture than respondents who had no previous farm background ($\bar{m} = 2.05$). This information is found in Table 27.

Table 27

Differences in Extension Agricultural Agents' Perceptions of Competencies in Sustainable Agriculture By Farm Background

Variable	<u>n</u>	<u>m</u>	<u>SD</u>	<u>t</u>
No farm background	53	2.05	.62	.00*
Farm background	277	2.52	.56	
Statistically significant differences were found between groups at the .05 level				

*p < .05

* $p < .05$

When investigating differences by 1862 or 1890 Extension Services, no statistically significant differences were found in perceived competencies of the two groups. This information is found in Table 28.

Table 28

Differences in Extension Agricultural Agents' Perception of
Competencies in Sustainable Agriculture By Type of Institution of
Employment

Variable	<u>n</u>	<u>m</u>	<u>SD</u>	<u>t</u>
1862 Agents	282	2.44	.59	.80
1890 Agents	48	2.46	.63	

CHAPTER 5: SUMMARY OF FINDINGS, CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

Prior to this study, no research had been conducted to describe extension agricultural agents' perceptions of sustainable agriculture in the Southern Region of the United States. Therefore, this study was designed to address this problem.

This problem was addressed by the eleven objectives as stated on page 8. These objectives were driven by the questions on page 4 that were posed as a result of the review of the literature.

Descriptive statistics were used to describe the agents' demographic characteristics and perceptions regarding sustainable agriculture. Analyses of variance and inferential t -tests were used to determine if the agents' perceptions of sustainable agriculture concepts, sustainable agriculture factors, sustainable agriculture trends, sustainable agriculture capabilities of the Cooperative Extension Services, and agents' sustainable agriculture competencies differed by age, agricultural background, educational background, and type of land grant institution of employment. The alpha level was set a priori at .05.

Summary of Findings

A summary of the findings of the study will be presented in the order of the objectives listed on page 8.

Objective 1: Demographic Characteristics of Respondents

The ages of the respondents averaged 42 years and their length of employment with the Cooperative Extension Service averaged 14 years. Over two-thirds (68%) had their Master's degree or their Doctoral degree while less than one-third (31%) had only a Bachelors degree. Undergraduate and graduate degrees were held primarily in the plant sciences, education, animal sciences, and agriculture business or agriculture economics.

Nearly one-half indicated their major time was spent working with small farms while approximately two-fifths worked with moderate to large farms. Less than ten percent spent major professional time with agricultural business or other agriculture production. Nearly one-third indicated that rural crop production was their major work area while just over one-fourth indicated their major work area to be rural livestock production. Approximately one-fifth were involved heavily in urban horticulture, rural horticulture or rural vegetable production.

Over two-thirds of the respondents grew up on a farm and worked on a production farm for parents while almost one-half had worked for pay on a production farm for one year or longer. Over one-third indicated they had operated a production farm while just over 10% indicated that they had neither lived on nor worked on a production farm, or that they had lived on but had not worked on a production farm.

Objective 2: Perceptions of Sustainable Agriculture Concepts

The respondents perceived that sustainable agriculture practices can be successfully used in production systems and that perennial grain crops need more research emphasis. They disagreed that insects, diseases, and weeds can be controlled in most production systems without the use of chemical pesticides. Respondents perceived that federal guidelines for acceptable levels of pesticides and other polluting agents found in municipal drinking water systems should be relaxed. Respondents did not perceive that chemical residues on many fruits and vegetables that are currently available in the market place pose a significant health threat to the consumer.

Objective 3: Perceptions of Sustainable Agriculture Factors

The respondents perceived that the Cooperative Extension Service and minimum tillage systems would have an overall positive impact on production agriculture during the next ten years. The respondents

perceived that increased nitrate levels in drinking and in irrigation water, increased pesticide residues in groundwater, a shortage of synthetic fertilizers, loss of productive land to population expansion, reduced water availability, salinization of water, severe erosion of major cropland, and increased use of marginal soils would have a negative impact on production agriculture. Respondents perceived that global warming would have no impact on the sustainability of production agriculture.

Objective 4: Perceptions of Sustainable Agriculture Trends

The respondents disagreed that cultural and biological control will replace chemical pest control in most major agricultural production systems within the next ten years. They perceived that large irrigation systems will adopt practices that will significantly reduce water usage.

Objective 5: Perceptions of Sustainable Agriculture Capabilities of the Cooperative Extension Service

The respondents perceived that the Cooperative Extension Service provides the major leadership in areas of sustainable agriculture in their county/parish and that more time and adequate funding were needed for training in sustainable agriculture.

Objective 6: Perceptions of Sustainable Agriculture Competencies

The respondents perceived themselves to be either slightly competent or moderately competent in the sustainable agriculture competencies investigated. The respondents' perceptions of competence level in the different areas of sustainable agriculture may be found in Table 12 on page 68.

Objective 7: Differences in Perceptions of Sustainable Agriculture Concepts by Demographic Characteristics

Statistically significant differences were found among the responses in the following areas: Respondents 33 years old and younger were more likely to agree with the ten sustainable agriculture concepts than agents 34 years and older; and respondents

working with small farm clientele were more likely to agree with the sustainable agriculture concepts presented than agents working primarily with moderate to large farm clientele or agribusinesses. Respondents employed by the 1890 Cooperative Extension Services were more likely to agree with the concepts presented in the questionnaire than agents employed by the 1862 Cooperative Extension Services. No statistically significant differences were found in responses by the following variables: technical area in which major amount of time was spent, farm or non-farm background, undergraduate major, and graduate major.

Objective 8: Differences in Perceptions of Sustainable Agriculture Factors by Demographic Characteristics

Statistically significant differences were found in the following area: Respondents with an undergraduate degree in the area of agricultural business or economics were significantly more likely to perceive that the factors would have a positive impact on the sustainability of production agriculture than respondents with an undergraduate degree in animal science or plant science. No statistically significant differences were found in the responses by the following variables: age, technical area in which the major amount of time was spent, graduate major, farm or non-farm background, and type of institution of employment.

Objective 9: Differences in Perceptions of Sustainable Agriculture Trends by Demographic Characteristics

Statistically significant differences were found in the responses by the following areas: Respondents working with small farm clientele were significantly more likely to agree with statements regarding trends and their relationship to the future of sustainable agriculture than respondents working with agribusinesses. The respondents working for the 1890 Cooperative Extension Services were significantly more likely to agree with the future trends as presented than respondents employed by the 1862 Cooperative Extension

Services. No statistically significant differences were found between the groups divided by farm or non-farm background.

Objective 10: Differences in Perceptions of Sustainable Agriculture Capabilities of The Cooperative Extension Service by Demographic Characteristics

Statistically significant differences existed in the responses by the following variables: Respondents who worked with small farm clientele were significantly more likely to agree with Extension's capabilities in sustainable agriculture than respondents working with moderate to large farms or respondents working with agribusinesses. Respondents with undergraduate degrees in the area of plant science were significantly less likely to agree with the capabilities of the Cooperative Extension Service in sustainable agriculture than respondents with degrees in animal sciences, education, and agricultural business or economics. Respondents with graduate degrees in the area of plant science were significantly less likely to agree with the capabilities of the Cooperative Extension Service in sustainable agriculture than respondents with graduate degrees in animal science or in education. Respondents with farm background were significantly more likely to agree with the sustainable agriculture capabilities of the Cooperative Extension Service than respondents who had no farm background. Respondents working for the 1890 Cooperative Extension Services were significantly more likely to agree with capabilities of the Cooperative Extension Service in sustainable agriculture than respondents employed by the 1862 Cooperative Extension Services. No statistically significant differences existed by age.

Objective 11: Differences in Perceptions of Sustainable Agriculture Competencies by Demographic Characteristics

Statistically significant differences were found among the responses by the following variables: Respondents who worked predominantly in rural technical areas perceived themselves to be

significantly more competent in sustainable agriculture than respondents working in urban areas. Respondents working in rural plant science areas or rural animal science areas perceived themselves to be significantly more competent in sustainable agriculture than respondents working in urban plant science areas. Respondents with farm background perceived themselves to be significantly more competent in sustainable agriculture than respondents with no farm background. No statistically significant differences existed by age, farm clientele, undergraduate major, graduate major, and type of institution of employment (1862 or 1890 land grant institutions).

Conclusions

The following conclusions are directed at extension agricultural agents in the Southern Region of the United States. Unless otherwise noted, the term "agents" will be used in the conclusions to represent this population.

Objective 1. Describe the demographic characteristics of extension agricultural agents employed by the Cooperative Extension Service in the Southern Region of the United States.

- a) The average agent is 42 years old and has 14 years of experience with the Cooperative Extension Service.
- b) The agents are a well educated group.
- c) Most agents hold undergraduate degrees in the plant sciences, animal sciences, education, or agricultural business or economics.
- d) Most agents have advanced degrees in the animal sciences, plant sciences, education, or agricultural business or economics.
- e) Most agents have farm background.
- f) Nearly one-half of the agents spend the majority of their professional time working with owners/operators of small farms (below \$50,000 gross income).

g) Over half of the agents spend most of their time working with crop production while over one-fourth spend most of their time working with livestock production.

Objective 2. Describe extension agricultural agents' perceptions of sustainable agriculture concepts in the Southern Region of the United States.

a) Agents perceive that most sustainable agriculture practices can be successfully used in production systems.

b) Agents do not perceive that major outbreaks of insects can be controlled without the use of chemical insecticides.

c) Agents do not perceive that most crop disease organisms can be successfully controlled without the use of herbicides.

d) Agents do not perceive that weed control in most cropping systems can be accomplished economically without the use of herbicides.

e) Agents perceive that perennial grain crops, with the potential for sustaining or increasing production with limited inputs, should receive more research emphasis.

f) Agents perceive that federal guidelines for acceptable levels of pesticides and other polluting agents found in municipal drinking water systems should be relaxed.

g) Agents do not perceive that chemical residues on many fruits and vegetables that are currently available in the market place pose a significant health threat to the consumer.

Objective 3. Describe extension agricultural agents' perceptions of factors and their potential impact on the sustainability of production agriculture in the Southern Region of the United States.

a) Agents perceive that the Cooperative Extension Service will have a positive impact on the sustainability of production agriculture during the next ten years.

b) Agents perceive that minimum tillage systems will have a positive impact on production agriculture during the next ten years.

c) Agents perceive that the following factors will have a negative impact on the sustainability of production agriculture: increased nitrate levels in drinking and in irrigation water, increased pesticide residues in groundwater, a shortage of synthetic fertilizers, loss of productive land to population expansion, reduced water availability, salinization of water, severe erosion of major cropland, and the increased use of marginal soils.

d) Agents perceive that global warming will have no impact on the sustainability of production agriculture.

Objective 4. Describe extension agriculture agents' perceptions of trends and their relationship to the future of sustainable agriculture in the Southern Region of the United States.

a) Agents do not perceive that cultural and biological control will replace chemical pest control in most major agricultural production systems within the next ten years.

b) Agents perceive that large irrigation systems will adopt practices that significantly reduce water usage.

Objective 5. Determine extension agriculture agents' perceptions of sustainable agriculture capabilities of the Cooperative Extension Service in the Southern Region of the United States.

a) Agents perceive that the Cooperative Extension Service provides the major leadership in sustainable agriculture in their local county/parish.

b) Agents perceive that more time and adequate funding should be set aside for training in the area of sustainable agriculture.

Objective 6. Determine extension agricultural agents' perceptions of competencies in sustainable agriculture in the Southern Region of the United States.

a) Agents perceive themselves to be slightly competent or moderately competent in sustainable agriculture competencies.

b) Agents perceive themselves to be slightly competent in the area of the use of trap crops, the use of cover crops in orchards, ridge tillage systems, solid waste product utilization, the integration of animal and plant systems, the use of computer software, and the use of green manure crops and cover crops.

c) Agents perceive themselves to be moderately competent in biological pest control methods, cover crops in vegetable production, minimum tillage, no-till, weed management, soil nutrient management and fertilization, crop rotational systems, and livestock rotational grazing systems.

d) Over one-half of the agents have received no training in the area of computer software dealing with sustainable agriculture topics. Agents perceive themselves to be less competent in this area than others dealing with sustainable agriculture.

e) Over ninety percent of the agents have received training in the areas of minimum tillage production systems and soil nutrient management and fertilization methods. Agents perceive themselves to be most competent in these areas.

Objective 7. Determine if differences exist in extension agricultural agents' perceptions of sustainable agriculture concepts by age, agricultural background, educational background, and type of institution of employment.

Agents 33 years old and younger are more likely to agree with sustainable agriculture concepts than agents 34 years and older. Agents working with small farm clientele are more likely to agree with sustainable agriculture concepts than those working with large farm or agribusinesses. Agents employed by the 1890 Cooperative Extension Services agree are more likely to agree with sustainable

agriculture concepts than agents employed by the 1862 Cooperative Extension Services.

Objective 8. Determine if differences exist in extension agricultural agents' perceptions of the potential impact of factors on the sustainability of production agriculture by age, agricultural background, educational background, and type of institution of employment.

Agents with an undergraduate degree in agricultural business and/or economics are more likely to perceive that selected factors will have a positive impact on the sustainability of production agriculture during the next ten years than are agents with an undergraduate degree in animal science or plant science.

Objective 9. Determine if differences exist in extension agricultural agents' perceptions of trends and their relationship to the future of sustainable agriculture by age, agricultural background, educational background, and type of institution of employment.

Agents working with small farm clientele are more likely to agree with sustainable agriculture trends than agents working with agribusinesses. Agents employed by the 1890 Cooperative Extension Services are more likely to agree with sustainable agriculture trends than agents employed by the 1862 Cooperative Extension Services.

Objective 10. Determine if differences exist in extension agricultural agents' perceptions of capabilities of the Cooperative Extension Service in sustainable agriculture by age, agricultural background, educational background, and type of institution of employment. Agents employed by the 1890 Cooperative Extension Services are more likely to agree with perceived capabilities of the Cooperative Extension Service than agents employed by the 1862 Cooperative Extension Services. Agents having farm background are more likely to agree with perceived sustainable agriculture

capabilities of the Cooperative Extension Service than agents with no farm background. Agents working with small farm clients are more likely to agree with the perceived sustainable agriculture capabilities of the Cooperative Extension Service than agents working with moderate to large farm clientele or agents working with agribusinesses. Agents with undergraduate or graduate degrees in the areas of the plant sciences are more likely to disagree with perceived sustainable agriculture capabilities of the Cooperative Extension Service than agents with undergraduate or graduate degrees in areas of education, animal science, or agricultural business and/or economics.

Objective 11. Determine if differences exist in extension agricultural agents' perceptions of competencies in sustainable agriculture by age, agricultural background, educational background, and type of institution of employment.

Agents working in rural plant science areas or rural animal science areas perceive themselves to be more competent in sustainable agriculture than agents working in urban plant science areas.

Agents with farm background perceive themselves to be more competent in sustainable agriculture than agents with no previous farm background.

There are no differences between the perceived competencies of the agents employed by the 1862 Cooperative Extension Services and agents employed by the 1890 Cooperative Extension Services.

Discussion

The research model for this study shown in Figure 2 (page 8), which was founded on the theoretical framework shown in Figure 1 (page 7), was based on the premise that the overall perceptions of sustainable agriculture held by extension agricultural agents are comprised of their perceptions of (a) sustainable agriculture concepts, (b) factors impacting the sustainability of production

agriculture, (c) sustainable agriculture trends, (d) capabilities of the Cooperative Extension Service in sustainable agriculture, and (e) personal competencies in sustainable agriculture. These perceptions are influenced by demographic variables that include age, agricultural background, educational background, and type of land grant institution of employment. The development of this study was supported and based on an investigation into the process of adult learning as presented by Malcolm Knowles (1977) that indicated the background characteristics (demographics) of individuals influence their perceptions.

The integration of the findings and conclusions of the study with regard to the objectives that were established by the premise of the research model provides a window to examine differences in agents' perceptions of sustainable agriculture. These differences in agents' perceptions of sustainable agriculture as established by the above demographic characteristics are presented in Table 29 in a summary format. Also, based on the above interpretation, it would seem that training needs of extension agents should be accentuated in the following areas:

- 1) Sustainable agriculture concepts for older agents (34 years and older), for 1862 agents, and for agents working with moderate to large farms and agribusinesses as compared to their respective counterparts;
- 2) Sustainable agriculture trends for 1862 agents, and for agents working with moderate to large farms and agribusinesses;
- 3) Sustainable agriculture competencies for urban agents working in the plant science areas, and for agents having no farm background.

Several questions were raised at the outset of the study (page 4). It would appear that these were partially, if not fully, answered.

Table 29

Differences in Extension Agricultural Agents' Perceptions of Sustainable Agriculture By Demographic Characteristics

Sustainable agriculture component	Demographic characteristics				
	Age	Agricultural background (farm or non-farm)	Clientele	Educational background (undergraduate/ graduate major)	Institution of employment
Concepts	Agents 33 years and older are more likely to agree with these concepts		Agents workings with small farmers are more likely to agree with these concepts		1890 agents are more likely to agree with concepts
Factors				Agricultural business and/or economics majors more likely to perceive positive impact	
Trends			Agents working with small farmers more likely to agree with trends		1890 agents more likely to agree with trends

(table continues)

Sustainable agriculture component	Demographic characteristics				
	Age	Agricultural background (farm or non-farm)	Clientele	Educational background (undergraduate/ graduate major)	Institution of employment
Capabilities of CES		Agents with farm background more likely to agree with CES capabilities	Agents working with small farmers more likely to agree with CES capabilities	Plant science majors more likely to agree with CES capabilities (under- graduate and graduate)1890 Agents more likely to agree with CES capabilities	
Competencies		Agents with farm background perceived to be more competent	Rural plant science or animal science agents perceived themselves to be more competent than urban plant science agents		

First, the study affirmed that these concepts and the emerging need for a sustainable agriculture land base are significant to training needs.

of extension agricultural agents, in that the Cooperative Extension Service must have expertise in sustainable agriculture to address the continuing needs of the agricultural community in the United States and abroad. As societal needs change and environmental concerns continue to escalate, the development and adoption of a sustainable agriculture technology that creates strong ties among the farmer-producer, the consumer, and the environmentalist become more and more critical to food production.

Second, it is not clear from the study whether or not the Cooperative Extension Service can provide the needed teaching services in the area of sustainable agriculture with present capabilities. However, this study revealed that extension agricultural agents working in the Southern Region of the United States perceive themselves to be weak or lacking in a large number of sustainable agriculture competencies. From the resulting data and analyses, it is questionable whether or not these agents presently have the needed capabilities to provide teaching services in sustainable agriculture technology.

Third, changes may be needed in the qualifications of new professionals employed by the Cooperative Extension Service. Although this study did not reveal strong positive or negative tendencies one way or another with regard to this question, support may be given to this concept because of the relatively low self-perceptions of sustainable agriculture competencies of agents working in the Southern Region. (Suggestions regarding this area are found in the Recommendations section.)

Fourth, it appears that personnel presently assigned to agricultural program areas may lack the needed expertise to teach

specific alternative agricultural concepts utilizing sustainable production methods. The study investigated field agents only, therefore this would apply only to that group. Extension agricultural agents working in the Southern Region of the United States perceived themselves only slightly to moderately competent in the areas of sustainable agriculture that were investigated by this study. The study did not address the competencies of state program specialists. It is interesting to speculate that if field agents need training in sustainable agriculture, and if state program specialists are to provide this training, just how competent are those at the state level? Do they have the needed expertise to teach agents about sustainable agriculture, and at what level?

Fifth, all agricultural production methods that are being taught and promoted by Cooperative Extension personnel may not be conducive to a sustainable agriculture land base. It was evident from the study that agents perceive a number of selected agriculture production practices are conducive to sustainable agriculture. Agents perceive that insect, disease, and weed control in most cropping systems can not be accomplished without the use of pesticides. However, several researchers (Altieri, 1992; Cunningham & Saigo, 1990; Pimentel, et.al., 1991; Schaller, 1993) have indicated that the continuing use of excessive levels of pesticides in agricultural systems can hinder their sustainability. Alternative pest control methods are being investigated and developed. The integration of the best of current and traditional methods may provide an improved blueprint for a sustainable agriculture land base.

Sixth, it is imperative that the Cooperative Extension Service undertake employee training in sustainable agriculture concepts leading to the development of farm production practices reflecting

the environmental concerns supportive of an emerging global agriculture.

The 1990 Farm Bill, according to Hoag and Pasour (1992), requires Extension agents to be trained in sustainable agriculture in order to develop understanding, competencies, and the ability to teach sustainable agriculture concepts and communicate with the farm community. The education program package is mandatory, and suggests that sustainable agriculture is socially beneficial and should be adopted. Also, according to Hoag and Pasour (1990), all Extension agents must complete a training program no later than November, 1995 and new agents hired after November, 1993 are required to complete training within eighteen months following employment. This would indicate that the Cooperative Extension Service must initiate training as needed in sustainable agriculture for extension agricultural agents in the Southern Region of the United States.

These concerns are directed towards agent training needs in sustainable agriculture. A curriculum that focuses on concepts, factors and their impacts, trends, and perceived levels of competencies of extension agricultural agents, therefore, appears to be appropriate as a base for this training.

Planning for training designed to enhance the sustainable agriculture capabilities of extension agriculture agents is presently underway by State Cooperative Extension Services. Federal seed money has been allocated to initiate this training. It is important to the future viability of the Cooperative Extension Service as a teaching organization in the Southern Region of the United States and to the preservation of an agricultural land base for future generations that the training needs of extension agricultural agents in sustainable agriculture be addressed.

Recommendations

The following recommendations are based on the conclusions of this study:

- 1) More time and funding should be allocated by the Cooperative Extension Service for agent training in the areas of sustainable agriculture.
- 2) A follow-up to this study should be conducted to determine if differences exist in the perceptions of competencies and actual competencies of agents in sustainable agriculture. Agents may actually be lacking in sustainable agriculture competencies or it is possible that they may only perceive that they are lacking in these competencies.
- 3) Administrators in the ranks of the Cooperative Extension may want to consider hiring only those candidates for employment as agricultural agents with specialized training and background in the area of sustainable agriculture. Consideration may also be given to the concept of requiring specialized course work or training in sustainable agriculture for "new hire" employees that come on as agricultural agents.
- 4) Agents need training that provides awareness in concepts and principles of sustainable agriculture.
- 5) Cooperative Extension Services should consider providing agents with training leading to the integration of technical agriculture disciplines into components of working sustainable agriculture applications. Agents may be competent in technical disciplines but may lack the ability to integrate this knowledge.
- 6) Agents need to be provided with information and/or training which will make them more in tune with current agricultural research as it pertains to the sustainability of agriculture on a global basis and more familiar with how this research influences local agricultural production. With the convenience of the electronic

media, this may be made available for Cooperative Extension professionals on a regular basis at the state and national levels.

7) A data bank (packaged program) for use by agents in the Southern Region of the United States is needed which will provide specific environmental applications for the integration of vegetables, agronomic crops, ground covers, and plant and animal rotational practices into an environmentally sound system to be used in teaching applications.

8) There is a need for Cooperative Extension Services to provide agents with training that will aid them in helping producers in the transition away from intensive chemical usage and towards sustainable production systems. This training should enable agents to promote the following sustainable agriculture practices: greater use of crop rotations using legumes, animal and green manures for use as soil builders, the integration of crop and animal production systems, mechanical weed control, and increased emphasis on soil and water conservation practices and the continuing use of biological pest control.

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APPENDIX A: SUSTAINABLE AGRICULTURE ACCOMPLISHMENTS OF THE
COOPERATIVE EXTENSION SERVICE - 1992

Auburn

Management and utilization of poultry litter was initiated as a alternative soil nutrient and replacement for purchased material, providing significant benefits for water quality, beneficial substitutes for commercial products and an environmentally safe and cost-effective means of recycling waste materials.

A statewide computerized agricultural weather program was begun; a joint effort involving the Alabama Cooperative Extension Service (ACES) and the NOAA/National Weather Service's Southeastern Agricultural Weather Service Center located at Auburn University. All 67 County Agents offices were connected to the system via phone modems. In October, 1989, the weather program was added to ACES' new "Acenet" computer network making access by county agents (CEAS) faster and easier.

Thistle weevils were released as a biological control of musk thistle in Alabama pastures.

As a participant in the LISA/FDSS Budgeting program, Alabama has continued an effort to employ a systems approach in the development of extension farm management programs. In the initial step, crop rotation budgets were developed in conjunction with the SMART Systems program to evaluate the consequences of systems strategies on net income (which includes governmental guidelines, environmental initiatives, production requirements, marketing opportunities, etc.). Eleven basic rotation schemes based on their feasibility and adoptability for Alabama agriculture have been developed. Funding was provided by an ES-USDA and Sustainable Agriculture Research and Education Program (LISA) grant. The ultimate goal of this program is

to enhance the sustainability, competitiveness, and profitability of farm operations in Alabama.

Connecticut

Techniques were developed for predicting weed infestations, thus allowing for determining potential weed pressure before the growing season, and reducing herbicide application.

The Spiny Soldier Bug was evaluated as a biological control for the Colorado Potato Beetle. Preliminary results show that this has significant value as a biological control agent.

Delaware

We C.A.R.E (Comprehensive Agricultural Resources Effort), was established within Delaware's inland bays to help producers develop an integrated nutrient, pest and conservation planning program.

A program was developed to study the feasibility of using Kenaf as a broiler litter in poultry production, and then feed that broiler litter to beef cattle. The study was funded at a level of \$81,000 over two years by USDA.

Forty-seven large poultry composters and over 240 mini-poultry composters have been built and placed on poultry farms as a way of dealing with poultry mortality.

Georgia

Plans were initiated to cooperate with the Agriculture Institute of the Tennessee Valley Authority to select farms in the TVA area for sustainable agriculture demonstration farms.

Hawaii

The three major areas of activity in sustainable agriculture centered around a USDA/SARE grant on grazing in orchards to reduce herbicide use, a state funded "LISA for Hawaii" project, and a private and publicly funded state conference entitled "Farming with Nature in Hawaii".

A special project provided funds to the NIFTAL Project (Nitrogen Fixation in Tropical Agricultural Legumes) to develop and present a 3-unit graduate level seminar to 12 extension agents.

A demonstration project on no-till techniques for taro production was observed by 60 people at a field day.

Idaho

The following definition was developed for Sustainable Agriculture: Sustainable agriculture is a philosophy that takes a farming-systems approach to using production inputs in ways that reduce costs, assure long term productivity of soil and other natural resources, protect human health and maintain farmer profitability. The methods of sustainable agriculture are specific to each farm situation but typically include three components: (1) integrated pest management (biological and cultural alternatives to chemical pesticides for disease, insect, nematode and weed control), (2) best management practices (reduced tillage methods used to decrease soil erosion and precision farming practices that match nutrient and pesticide inputs to variation in farm landscapes), and (3) nutrient recycling involving the use of on-farm animal or green manures as well as rotations with legumes.

Iowa

Iowa's sustainable agriculture programs have focused on nitrogen management. More than 100 on-farm demonstrations on nitrogen management have been established statewide. Emphasis has been placed on the late spring soil nitrate test for improved timing and efficiency of nitrogen use.

Iowa Extension cooperates with Practical Farmers of Iowa on sustainable agriculture education for high school vo-ag teachers.

Kentucky

A joint effort between the Martiki Coal Company and the University of Kentucky Cooperative Extension Service accomplished a

demonstration project on reclaimed surface mined land. The project included 500 small fruit trees, drip irrigation, soil erosion control, best management practices, fencing, IPM, cultivation, etc.

Massachusetts

Commercial vegetable growers are experimenting on their farms with 32 plantings of alternative cover crops for the purpose of reducing inputs of nitrogen fertilizer. Hairy vetch, a nitrogen fixing legume, forms the basis of these systems. When planted in the fall, together with a cereal such as oats or rye, the hairy vetch supplies nitrogen. The cereal crop captures excess residual inorganic nitrogen during the fall and winter following the harvest of the main crop. By adopting these cover crop strategies, farmers can reduce costs associated with purchase of commercial fertilizer and lessen the potential for ground water pollution.

By the manipulation of apple tree shape and structure, commercial orchards have adopted dwarfing rootstocks. In addition to other advantages, this allows growers to reduce pesticide applications by 75%. Additionally, the small tree canopy has better air circulation through it resulting in fewer fungal diseases. Summer pruning and root pruning are also methods growers use in existing orchards to improve air circulation.

Minnesota

On-farm evaluation of sustainable agriculture practices is a project sponsored by the Southwest Farm Business Management Association (SFBMA) and funded by the Agriculture Utilization Research Institute (AURI) and SFBMA. The project consists of evaluating various sustainable agriculture practices on the basis of input costs, output, economic returns that include labor requirements, and energy use. The practices evaluated the following:

- 1) Reduced herbicide usage with banding;
- 2) Increased mechanical weed control, and the use of post emergence products;
- 3) A comparison of conservation tillage methods with conventional tillage (this includes fall chiseling, ridge tilling, slot tilling and no-till);
- 4) Managing manure as a resource to replace commercial fertilizer; and
- 5) Following soil test recommendations which compared the application of fertilizers by banding and by broadcasting.

Research demonstration plots located on 14 farms in Southwest Minnesota were made accessible to many farmers in each of the areas. Yields of corn on conventional, min-till, and no-till have been very close to the same over the last three years, while input costs have been \$6 and \$14 less than conventional for min-till and no-till, respectively. Selected net returns have been \$6.50 and \$14.50 higher for min-till and no-till compared to conventional tillage. Soybeans have shown the same yield tendencies for the past three years and the selected net returns have been \$3 and \$6 per acre higher for min-till and no-till respectively, compared to conventional tillage.

Missouri

A training session was held in Columbia, Mo. to teach regional specialists to use the SMART farm decision support system. The session was attended by farm management, agronomy, and agricultural engineering specialists from throughout the state. Specialists, the Soil Conservation Service, and a private non-profit agency also attended.

Educational programs were developed and implemented with information on the use of forages, family labor, and the selection, nutrition, herd health, and markets for raising and selling commercial sheep, goats, and rabbits. The purpose of these programs

was to increase profitability, family unity, and cooperator participation with direction towards these goals.

Sixteen videotapes were developed and distributed to 56,000 viewers in Missouri and eleven states on production, grading and commodity marketing. Eight videotapes of field days on selected farms resulted in hands-on-training as well as work-shops held at Lincoln University for the producers.

Missouri Sheep Improvement Program written for the PC has enrolled and logged over 20,000 sheep, in order to assist producers in decision-making directed toward culling or keeping ewes and ewe lambs for breeding stock.

New Hampshire

As a direct result of Extension programs, farmers improved utilization of manure and pasture land, decreased fertilizer use, and adopted legumes as cover crops and interseedings.

Extension released parasitic wasps and other beneficial organisms for insect control. These demonstrations were used to educate farmers to other means of insect control.

Dwarf grasses were adopted by several orchardists to reduce mowing, labor and energy expenditures. Other biological controls, such as planting marigolds to repel nematodes have been used by New Hampshire producers.

Producers also adopted the use of plastic mulches, floating row covers, living mulches, and high tunnels for reducing inputs and extending their marketing seasons. High tunnel use eliminates the need for herbicides, reduces fungicide use by about 99% and reduces insecticide use by 85% or more. Over 30 new high tunnels devoted to vegetables were erected this year. Greenhouse temperatures can be used to control plant height, eliminating the need for growth retardants.

A computerized soil-test based program was developed which recommends the use of multiple nutrient applications. The investigation and implementation of sustainable agriculture programs include initiation of the following:

- 1) Soil Nitrate testing and reduced fertilizer use;
- 2) Improved utilization of manures;
- 3) Improved efficiency in cattle feeding;
- 4) Use of legumes as a fall cover crop;
- 5) Interseeding of legumes in vegetable crops;
- 6) Increased pest identification prior to pesticide applications;
- 7) Incorporation of composting and living mulches into production systems;
- 8) Leaf chopping in orchards reducing ascospore potential;
- 9) Increased use of plastic mulches, row covers and light tunnels;
- 10) Use of brassicas for fall grazing;
- 11) The reduction of dependence on imported bees for pollination;
- 12) Introduction of parasitic wasps and other beneficial insects;
- 13) Adoption of dwarf grasses in orchards;
- 14) No-till seedings in hay and athletic fields;
- 15) Use of netting to replace chemical bird control;
- 16) Improved utilization of intensive pasturing practices;
- 17) Use of marigolds for nematode control;
- 18) Increased cultivation in corn to replace herbicide use;
- 19) Submission of a grant directed towards expansion of marketing opportunities for goat milk;
- 20) Ostrich and emu production operations initiated;
- 21) Baby potato and baby lettuce added to vegetable production mix;

- 22) The utilization of sudan grass and peas as summer forage;
- 23) Sunflowers planted with corn as a silage crop;
- 24) The beginning of four vegetable production systems utilizing community supported sales;
- 25) Several new operations directed towards the fresh herb market;
- 26) Development of two new golf courses;
- 27) Erection of over 30 new high tunnels; and
- 28) Two IR-4 research projects underway; 1) the study of diuron on blueberries, and 2) the use of paraquat for weed control in summer squash.

Pennsylvania

Cooperating, in 1992 with the Rodale Institute, the University formed the Penn State/Rodale Center for Sustaining Agriculture and Natural Resources in Urbanizing Environments (SANRUE). This joint center draws upon the expertise of both institutions with the goals of conducting a wide range of research and educational activities that contribute to the goals of a more sustainable and ecologically sound agriculture and natural resource utilization by focusing on urban environments. Seed monies are provided by the U.S. Department of Agriculture.

Rhode Island

The focus of the sustainable agriculture program has been to determine the present perceptions of the broad-based agricultural community toward the concept of sustainable agriculture, and to seek out through surveys and program testing the most appropriate means of delivering information on sustainable agriculture to that community.

A small gain has been made by introducing the idea of growing tomatoes in "high tunnels," a technique combining protection from foliar diseases with increased production from an extended season.

This is very difficult to achieve in our climate under organic restrictions of fungicides.

The RISA Newsletter focused on topics such as the use of hairy vetch with winter rye as a cover crop, specifically targeting reduced costs and expected savings on nitrogen fertilizers.

The concept of vegetable farmers introducing cut flowers into their cropping patterns was developed and implemented, not only for the relatively high value of flowers, but also as a potential rotation crop for farmers, to provide additional returns per acre.

The principles of infrared transmitting mulches for greater cucurbit production was introduced. Several farmers are now using this mulch.

The use of flammes for Colorado Potato Beetle control was developed and introduced. The implementation of a demonstration project involving flame weeding was accomplished. Sterile seedbed technique combined with flame weeding may provide a combination that could gain significant acceptance.

Tennessee

"Agri-21", is a cooperative effort among the Tennessee Valley Authority (TVA), the University of Tennessee Agricultural Extension Service, and other land grant institutions in the TVA region. The University of Tennessee Agricultural Extension Service is taking a leadership role in this innovative effort, and leadership at the University of Tennessee is being provided by the Sustainable Agriculture Targeted Program Committee. The objectives of this program are to demonstrate sustainable agriculture technology, and to develop an awareness of critical agricultural issues and alternative solutions. Strategic methods will include environmental preservation and protection tactics such as use of appropriate BMPs for conservation compliance, IPM, nutrient management, wetlands management, livestock and hazardous waste management, drinking water

assessment and protection, improvement of profitability through improved farm planning methods, intensive record keeping, use of appropriate marketing techniques, and environmental education via tours and mass media.

Texas

In response to the need for full-scale development and testing of sustainable agriculture concepts, a unique partnership established a 160-acre pilot farming operation. AG-CARES (Agricultural Complex for Advanced Research and Extension Systems) is a joint effort of the LaMesa Cotton Growers, The Texas Agricultural Extension Service and the Texas Agricultural Experiment Station. Practices being demonstrated on the farm include:

- 1) Conservation tillage systems that reduce soil and water erosion and optimize economic returns;
- 2) Water conservation with LEPA irrigation;
- 3) Alternative crops, such as sesame and small grains; and
- 4) Computer crop development and economic modeling.

Utah

The development of the PLANETOR sustainable agriculture decision support system (DSS) has been made available to Extension agents nationally with financial assistance from USDA-ES, USDA-SCS, and EPA. This system has been specifically tailored to the Utah soils, environment, and cropping systems.

A survey of farmers and ranchers revealed the following practices that may be easily adopted and that provide substantial beneficial impacts to the environment, the community, and the producers:

- 1) The addition of reduced tillage practices including no-till, on production forage and pasture lands;
- 2) The discontinuance of triazine and long-half-life herbicides in favor of a mixture of residue-conserving fall chisel tillage and safer glyphosate herbicide combinations;

- 3) The inclusion of legumes such as Miranda protein peas and forage peas in traditional monoculture (silage, corn, or grain) systems; and
- 4) The reduction of over-application of fertilizers and manures by encouraging appropriate soil testing techniques (includes proper nitrate nitrogen sampling).

Vermont

The following Demonstrations have been developed and implemented:

- 1) Tillage and cover crops in corn silage at Vermont Technical College;
- 2) Alternative crops such as garlic, sweet potatoes and hops;
- 3) Cover crops in vegetables and field corn promoting the reduction of soil erosion, and improving nitrogen recycling;
- 4) Cultivation verses herbicides for weed control; and
- 5) The utilization of manure nutrients for corn and grass hay.

Washington

Canola and various varieties of peas and lentils are among the alternative crops being tested in Eastern Washington. "Matua" is a new forage crop being tested in western Washington.

Twenty-three thousand PNW producers with highly erodible cropland increased their knowledge of how to measure surface residue and manage tillage operations to retain it on the surface through the publication called Residue Management Guide: Small Grain Residue in the Pacific Northwest.

Several farms in Eastern Washington are receiving Seattle Metro biosolids as an alternative fertilizer source. Over 28,000,000 pounds of biosolids were applied to 740 acres of summer fallow in place of normal nitrogen fertilizers.

Variable fertilizer rate biosolids research plots were established in spring wheat and in summer fallow for the 1992-93 winter wheat crop.

A new forage crop "Matua" is being tested in Western Washington. This crop is a New Zealand prairie grass. It has high nitrate uptake ability, excellent growth habits and good palatability. "Matua" has the potential to be a new productive, environmentally sound forage crop, highly desirable in western Washington with its high rainfall and high water table.

As a result of on-farm testing and education programs, one vegetable grower has contracted to grow 100 acres of garlic next year, a potential profit of \$200,000.

An Extension engineer conducted applied research to determine how much weight loss can be reduced in Golden Delicious apples by storing them at higher humidity levels. Humidifiers were used to increase humidity. A typical Washington warehouse packing two million boxes of apples per year could increase gross returns by \$300,000 per year, if one percent of the fruit weight could be saved.

Wisconsin

A frequent characteristic of sustainable agriculture programs is the participation of people from other agencies and entities. Cooperating agencies include the Wisconsin Department of Agriculture, Trade and Consumer Protection, county Land Conservation Committees, Soil Conservation Service, crop consultants, agricultural suppliers, and other groups which share objectives and assist with the accomplishment of educational goals.

A key component in the development of sustainable agriculture programs is the Nutrient and Pest Management (NPM) program which is part of the Center for Integrated Agricultural Systems (CIAS). NPM activities at the state and local levels are directed by producers who are either on the advisory board to CIAS or who work hand in hand with NPM specialists to develop a demonstration project to be conducted on their farms. Thus farmers are active participants in the planning as well as the execution of the projects on through to

the interpretation of the results. The host farmers are usually the first speakers at field days and tours held on their farms.

Extension professionals have cooperated closely with the Michael Fields Agricultural Institute in conducting an extension field research and extension project funded by a variety of sources. These include the Kellogg Foundation, NPM, Michael Fields Agricultural Institute, and the Cooperative Extension Service. The research and demonstration project is a long-term effort to both research and demonstrate the effects of six different crop rotations using different technologies which contribute to increased farm profitability and decreased use of chemicals in agriculture. The project is at two sites on different soil types and in different parts of the state. Field days were held throughout the year and served to bring farmers, extension professionals, consultants, and agribusiness people together to view and discuss the results and implications.

Sustainable agriculture efforts included cooperation with NPM, Integrated Pest Management, Sustainable Agriculture Program groups of the Department of Agriculture, Trade and Consumer Protection, and to develop and publish producer oriented publications on a variety of sustainable agriculture topics. Recent examples include the following: 1) A Simple Technique for Predicting Future Weed Problems, 2) Reduce Herbicide Rates: Aspects to Consider, 3) The Bottom Line: an Economic Summary of NPM Practices, 4) Nutrient Management: Practices of Wisconsin Corn Production and Water Quality Protection, 5) Nitrogen Credits for Manure Applications, 6) Credit What You Spread and Reap the Profits, 7) Preplant Soil Nitrate Test Saves Money, Protects Groundwater, 8) Using Legumes as a Nitrogen Source, 9) Scouting Corn: A Guide for Wisconsin Corn Production, and 10) 1991 Nutrient and Pest Management On-farm Demonstrations: Balancing Water Quality and Farm Profits. (Extension Service, 1993)

APPENDIX B: SUSTAINABLE AGRICULTURE ACCOMPLISHMENTS OF THE
COOPERATIVE EXTENSION SERVICE - 1993

ALABAMA A&M

Funding has been received to establish a sustainable agricultural teaching program at Alabama A&M University. This program will include the establishment of several systems which include agronomic and horticultural enterprises. Economic and production information will be collected from these systems. These teaching programs will also be available for training agents and clientele.

AUBURN

Alabama's \$195 million dollar woody ornamentals and greenhouse industry is listed each year as Alabama's number one or two agricultural crop (about \$780 million). Preservation of water resources, both quality and quantity, is the number one priority for the ornamental horticulture industry and all of agriculture.

Total irrigation for the container industry in the state is estimated at 50 thousand acre feet annually. Between 20,000 and 40,000 gallons per acre per day of irrigation moves off the container site as runoff. The reduction of this runoff is a major concern due to the nitrates and other pesticide contaminants which are part of the solution runoff. Auburn extension personnel and research faculty have initiated and organized a link between the nursery industry, ADEM and Alabama Department of Agriculture Division of Plant Industries to develop voluntary Best Management Practices for the industry to eliminate or minimize any production practices that might be adversely affecting our water supplies.

Extension displays at ANA's Nursery Trade Show providing information to over 5,000 industry professionals. Two hundred participants attended a one day program in June to define the

concerns and solutions that have been developed. A fact sheet that was developed for distribution by the agents and the Nursery and Greenhouse Newsletter highlighted the Best Management Practices for the industry professionals. Over 6,000 industry professionals have been presented with educational information on conserving our water resources in the nursery and greenhouse industry in Alabama.

Micro-irrigation technology has been developed to enhance the productive capability and quality of fruit and vegetables. Adaption of this technique has progressed to some extent in Alabama, but many producers are still unfamiliar with the capabilities and limitations of this practice. The beneficial aspect from the standpoint of energy and water savings are reasons to encourage adaptation of this technology. A proposal for micro-irrigation was funded for more than \$40,000 and later a supplemental grant for an additional \$6,000 was obtained. Handbooks were completed in 1993 and disseminated to county agents, extension specialists, micro-irrigation equipment suppliers, dealers, and consultants. The Agricultural experiment station and Horticulture and Agricultural Engineering departments are evaluating this technology for varieties of fruit and vegetable crops in the state.

ILLINOIS

The quarterly publication, "Agro-Ecology Technical Notes", emphasizing participatory on-farm research, began in the spring. In a joint initiative of CES and AES, the college appointed a staff position in an effort to strengthen working relationships and communication between the College and farmer-based sustainable agriculture organizations. During the year, an appointment was made in the position of on-farm research coordinator, another joint initiative of CES and AES. A new faculty position in Environmental Education has been established and filled. This focus and that of natural resources are being integrated into the agro-ecology program.

Training in sustainable agriculture was provided to 50 Extension field staff through their involvement and participation in demonstration projects. Two new LISA/SARE projects were initiated during the year. A total of 68 demonstrations were conducted by farmers and cooperators addressing nitrogen fertilizer reduction in corn, reduced herbicide use, and tillage and rotation systems and their impact on soil tilth and root growth. Several courses have been added in the College that relate to sustainable agriculture: Agronomy 337 (Agroecology); Forestry 250 (Contemporary Issues in Natural Resources); Forestry 140 (Ecology of Agricultural and Forest Systems); and AgEcon 210 (Economics of Agriculture and the Environment). All freshmen in the College are required to enroll in the course "System Approaches to Agricultural Problems". The Department of Agronomy has a new undergraduate major titled Agroecology. The College also features a new graduate program in Natural Resources, Ecology, and Conservation Biology offering Masters and Doctoral degrees. New graduate programs in Natural Resource and Environmental Sciences are offered by the Department of Forestry. Future activities include work toward the establishment of a research and education grant program funded with fees from the sale of fertilizer and pesticides and the establishment of a farmer-to-farmer mentoring program.

Iowa

University data show that two out of three farmers feel that they must rely too much on pesticides in normal agriculture practices. This statement by Iowa farmers causes Iowa State Extension to provide leadership in sustainable agriculture. A teachable moment exists for change in production agriculture in Iowa.

Kentucky

Agri-21 is a comprehensive demonstration of profitable and sustainable agriculture farming systems for the 21st century

supported by the Tennessee Valley Authority Agricultural Institute. Cooperators in Kentucky include farmers and their families and the University of Kentucky. Objectives include the following:

- 1) To develop, test, demonstrate, and evaluate technology that will be required to maintain sustainable farming operations in the 21st century.
- 2) To educate and/or improve the awareness of professional agricultural workers, farmers and their families, the agricultural community, and the general public of critical agricultural issues and alternative solutions.

Agricultural development councils have been developed in 99 Kentucky counties. Their goal is the development of promotional activities that will sustain agriculture within their region and all regions of Kentucky. Council members represent a cross section of agriculture interest in their respective counties. Each council hopes to attract and/or create new economic opportunities for the commodities and natural resources within their region.

MARYLAND

Profitable Agriculture and a Clean Environment (PACE) is a Maryland extension program that promotes farming systems and cultural practices which increase agricultural profitability while enhancing the environment. PACE is the principal extension vehicle for encouraging sustainable agriculture in Maryland. A major component of PACE is its adaptive research partnership with the farming community. Farmers and extension faculty work together on the farm exploring different agricultural systems. The value of this partnership is that it fosters a practical, site-specific, whole farm approach to understanding the profitability and environmental impacts of possible farming practices. In 1991, there were 33 on-farm PACE projects involving 60 farmers and 37 extension faculty. In FY 92, there are 38 PACE projects with 68 farmers and 55 extension faculty.

A FY 91 PACE Update and FY 92 PACE Update were published and 700 copies of each distributed. Conferences have been held where participants share their results. There are 34 projects in process for 1993. It is important to note that many of our sustainable agriculture efforts are contained under other Maryland issues such as water quality, profitability and environmental integrity, land and soil resources, and alternative agriculture enterprises. The PACE program is our major extension vehicle for sustainable agriculture in Maryland. However, there is a considerable effort taking place in other issues related to and supportive of sustainable agriculture. Listed below are some of the 1993 PACE projects:

- 1) Intensive grazing management for Central Maryland;
- 2) Raising organic vegetables for the Washington market;
- 3) Community supported agriculture (CSA) (a new option for diversified farms);
- 4) Eastern corn root worm: evaluating sampling techniques and yield loss in field corn;
- 5) Mechanical control of white grubs in turfgrass;
- 6) An overview of nutrient management A winning combination of technology and common sense;
- 7) Utilization of poultry carcass compost as a component in a soilless potting Mix;
- 8) Integrated pest management for tobacco in southern Maryland;
- 9) Using pre-sidedress nitrogen test for field corn;
- 10) Biorational (biocompatible) powdery mildew control on gooseberries;
- 11) Early blight susceptibility of commercial and heirloom (Potato-leaf type) tomato varieties;
- 12) Solar powered trickle irrigation system in vegetable production;
- 13) Growing asian pears in Southern Maryland;

- 14) Multiple bio-control methods for corn earworm and European corn borer in successive plantings of organic, fresh market sweet corn;
- 15) Total plant management/integrated pest management for perennial nursery crops;
- 16) Total plant management/integrated pest management for ornamental cabbage and kale production in nurseries;
- 17) No-till corn yields for vetch vs. winter annuals;
- 18) Small grain response to poultry manure;
- 19) Chandler plastic culture, conventional vs. organic; and
- 20) Evaluation of various soil and tissue test kits for testing and making in row nitrogen applications for plastic mulched melons.

NEBRASKA

This past year included both clientele outreach and organization building within the Institute of Agriculture and Natural Resources. The Center for Sustainable Agricultural Systems (CSAS) continued to grow and expand its influence. As the Extension delivery arm of CSAS, we worked closely to promote sustainable agriculture systems. Some CSAS supported projects included: A seminar series entitled "Designing the 1995 Farm Bill," which focused on increasing the emphasis on sustainability in the farm bill; the annual sustainable agriculture tour that had increased attendance this year over last year; a series of workshops entitled "Decisions for Successful Farm Management" that integrated production practices and farm management in a sustainable agriculture context. The major accomplishment of the year was the publication "Focus on Sustainable Agriculture" brochure. This brochure was the result of two years of effort. All departments were polled on which of their programs they defined as sustainable. The brochure was arranged by the areas of agricultural productivity, crop production, livestock production and natural and

human resources. Through cooperation with ASCS, the brochure was distributed to every landowner and producer in the state and all extension personnel. The brochure shows with specific examples the kinds of programs that contribute to sustainable agriculture. In addition, it shows the breath and extent of activity at the University of Nebraska. Besides the network of extension educators developed in 1992, each of the five extension districts developed their own sustainable agriculture or ag profitability team to promote site specific programs in their area of the state. Extension circulars were published in on-farm experimental design for use by clients and extension staff. The large increases in the number of sustainable agriculture programs and demonstrations are due to increased interest in working directly with producers with on-farm activities. The 650% increase in volunteer hours reflects donated labor by farmers while conducting field trials. Extension staff reported in narratives and anecdotal evidence that producers are more interested in the interrelationships among components than in the past. Pressure is being put on specialists to produce programs that bring together disciplines and present information as part of a larger system that includes environmental, economic, and production impacts. Extension is working on innovative techniques to successfully accomplish these goals. Because of the complicated nature of system approaches, two initiatives are being started. The Integrated Crop Management and Integrated Resource Management Priority Initiatives will focus on crops and livestock, respectively. Manure management continued to have important activities this year. Major efforts by the pork, poultry, and beef industry with extension are highlighting best management practices with manure management under many conditions. Field demonstration that use animal manures in crop nutrient management programs combined with presentations and computer software evaluation has brought attention to this problem

and has shown how to successfully reduce potential problems. Next year animal manure utilization will have a special priority team to continue the work started by the sustainable agriculture systems initiative. In conjunction with the Center for Rural Affairs, the Beginning Farmer Sustainable Agriculture Project continues to help young and new farmers establish themselves and adapt sustainable practices right from the beginning. Extension provides the leadership in producing detailed financial instruments for the 11 beginning farm families.

Individuals specifically looking for help in adopting sustainable agriculture practices can get the assistance they need from other producers. The Nebraska Sustainable Agriculture Mentor Program provides support to connect expert farmers with interested producers. This should provide the in-depth practical advice that is necessary to make a proposed change successful. A combined effort of many specialists and extension educators led to the development of a field record keeping notebook. The notebook will be the first step in encouraging record keeping as a way to make management decisions in row crop production.

NEW JERSEY

More than 25 research and education projects dealing with sustainable agriculture were started or continued in New Jersey since October 1, 1992. Crops included vegetables, fruit, and field crops. Funding for many of the projects came from the New Jersey Agriculture Experiment Station in the form of a sustainable agriculture grant program. Many of the studies were conducted at the Snyder Research and Extension Farm, the designated center for sustainable agriculture research. New Jersey is part of the LISA Apple Production Project. Scab resistant apple varieties were evaluated and showcased to more than 700 growers at the annual Mid-Atlantic Variety Showcase. In peaches, information on disease tolerance and susceptibility to brown

rot and bacterial leaf spot was published in the American Fruit Grower. This report is based on ongoing work examining peach varieties around the state. In vegetable production, an ongoing study compared organic, reduced input, and conventional systems in tomatoes, pumpkins, and sweet corn. This study was used to create crop budgets within Planator and Budgetor, allowing farmers to decrease their inputs without losing quality. Living and dead mulches are also being studied to determine their effectiveness in weed control and nutrient availability. An educational program has been developed for the adoption of improved practices for vegetable production, focusing on reduced costs per unit of production. Focus areas include, 1) production of high quality staked tomatoes, 2) fertigation (fertilizer applied in irrigation water) to make the most efficient use of fertilizer, and 3) use of mulches for early cucurbit production. Results of these studies were presented at the annual vegetable grower meeting with more than 1,500 in attendance and at numerous county meetings around the state. Research and extension efforts continue on leaf sheet composting or leaf mulching. Enhanced soil tilth, moisture retention, and productivity was documented in field corn, soybeans, and vegetable crops. Payments from the municipality to the farmer for accepting municipal leaves has provided an additional income source for growers. This practice links urban and rural problems and solutions in a mutually beneficial way. Presentations were made at six grower workshops, seminars, professional societies or conferences on the use, benefits, and research progress on leaf mulching. Three fact sheets were written dealing with organic agriculture. The first "Organic Certification of Agricultural Products", was written for farmers, producers, and interested growers. The second "Nutrient Sources for Growing Plants by the Organic Method", was written for commercial growers and gardeners. The third fact sheet "Organic Foods: What Do We Mean?"

was written for consumers/general public, to be utilized by the Extension Home Economics Department. In vegetable crops, use of trickle irrigation has increased significantly over the last two years. These growers have increased their irrigation and fertilizer efficiency, decreased leaching problems, and increased yields and profits. Growers have begun to adopt a disease forecasting system in fresh market tomato production. This system allows for fungicide sprays to be targeted only during times of possible infection. One grower who adopted this practice was able to decrease disease sprays by 50% and save more than \$300 per acre.

NORTH DAKOTA

The Extension/Research task force team (12 members) has been identified to work on low input agricultural production strategies. The backbone of our organization is the discipline-based specialist. This multi-disciplinary team is given incentive by the clear objectives of discovering lower cost production techniques which preserve the environment and bring about sustainable agriculture systems. The NDSU Extension Service used news releases and media (radio and television) to promote sustainable agriculture. Topics on alternative agriculture were included as part of regular county or multi-county educational meetings. Extension agents and agricultural specialists cooperated and assisted with tours and demonstrations on sustainable agriculture, IPM and alternative agricultural practices. The NDSU Extension Service supported and assisted with Marketplace 93 in Bismarck, North Dakota (over 5,000 attended). NDSU Extension helped promote and educate farmers about the SARA Farmer Grants Program. A number of county agents and state specialists have worked with and provided assistance to organically grown certification organizations. Demonstrations using angora goats for leafy spurge control were successful. These successes were demonstrated through tours and educational meetings.

The following current publications have been produced:

1. Crop Rotations for North Dakota, Ext. Bulletin 48;
2. Crop Rotations for Profit in North Dakota, Ext. Cir. A-1059;
3. Crop Rotations for Management of Plant Diseases, PP-705;
4. Weed Control With Winter Rye, A-199;
5. Alternative Crop Production Research - Progress Reports 1993;
6. Evaluation of Low-Input Crop/Livestock Production Systems;
7. Switching to a Sustainable System - author Fred Kirschenmann, The Northern Plains Sustainable Agriculture Society;
8. Sweet Clover Production and Management, Ext. Cir. R-862;
9. Rye Production and Utilization, Ext. Cir. A-916;
10. Buckwheat Production, Ext. Cir. A-687;
11. Canola Production, Ext. Cir. A-686;
12. Mustard Production, Ext. Cir. A-935;
13. Crambe Production, Ext. Cir. A-1010;
14. Safflower Production, Ext. Cir. A-870;
15. Lupin Production, Alternative Ag. Series No. 8; and
16. Farming Practices for a Sustainable Agriculture in North Dakota, Ag. Exp. Station Bulletin.

Active farmers are the strength to most sustainable agriculture programs, both in research and extension (education). The input and advice of farmers is invaluable to each state program. According to a recent report, a total of 111 North Dakota farmers have participated in LISA research and education projects. Twenty-nine are reported to have helped generate ideas for projects and 14 assisted in the management of the project. Land has been provided by 10 farmers for replicated experimental research and another 53 provided land for unreplicated demonstration studies. A number of

farmers also have been speakers at University Research Center field days and tours.

Diversifying the biology and the economy of North Dakota agriculture could be met by discovering new ways of integrating and re-introducing livestock back into the agroecosystem. By including the ruminant animal in an agroecosystem, opportunities are presented in the development of sustainable or low-input strategy for the production of products which society demands. While North Dakota State University plans on working on crop only agroecosystems, much additional effort will be spent on the exploration of new and efficient means of integrating livestock and crops into a single agricultural production system.

The key to sustainable agriculture is to continue a level of production that is profitable with reduced purchased inputs and additional management, keeping in mind the stewardship of our national resources. A base of productive farm land, clean water and producers with the necessary management skills will insure the availability of a food supply into the next century.

The objectives of this program follow:

- 1) To promote crop, livestock and enterprise diversification for the well being of whole farm sustainable systems.
- 2) To identify farmer practices that appear to be workable and with potential for improving sustainability of agricultural systems and to communicate this information to other farmers and researchers.
- 3) To expand IPM beyond the concept of simply managing pests to complete sustainable agriculture systems.
- 4) To expand the focus of IRM systems (Integrated Resource Management) with crops and livestock for the purpose of attaining sustainability by achieving a balance of

profitability, environmental soundness and social acceptability.

- 5) To develop and provide information and educational resources on organic farming.

Oklahoma

The Oklahoma Mesonet was commissioned and consists of 110 state-of-the-art weather stations tied together to give producers real-time decision making information. Immediate production practices that impacted growers were:

- 1) Insect management decision-making (alfalfa);
- 2) Varietal selection assistance (cotton);
- 3) Irrigation management, (cotton, corn, and peanuts); and
- 4) Animal heat and cold stress.

This system reaches 20,000 youth and 5,000 growers annually.

Efforts were made in manure management from the extensive poultry houses in eastern Oklahoma. Demonstrations included optimal manure application to reduce run-off, composting of carcasses, improved facilities construction, and a strong emphasis on tying together the economics and environmental issues. These efforts impacted chicken managers who own over 100,000 million birds. Significant reduction of non-point pollution was shown on 50 large production units.

Oklahoma has started an interdisciplinary Extension Integrated Resource Management effort that includes 6 disciplines and is a concentrated effort to develop a sustainable agriculture initiative within the college of agriculture.

PENNSYLVANIA

The College of Agricultural Sciences at Penn State University in partnership with two newly formed organizations in Pennsylvania has a rapidly expanding program of research and education in sustainable agriculture. In 1993 the College together with SANRUE and the Rodale Institute have undertaken several joint activities in the sustainable

agriculture arena as they pertain to urban environments and the rural agricultural interface. These activities involve both research and educational activities with personnel from both institutions cooperating. SANRUE has funded 6 new projects under a combination of CSRS and USDA funding including projects in composting, community systems approach to developing a regional marketing infrastructure and advanced IPM for apple production. SANRUE has also received a \$1,000,000 grant from Kellogg for a 3.5 year project to establish a regional infrastructure for sustaining agriculture that includes core team partners of The American Farmland Trust, Atlantic Dairy Cooperative, League of Women Voters, and the Reading Terminal Farmer/s Market Trust, with an additional 20 local organizations from the public, private, and non-profit sectors cooperating. The recently created Pennsylvania Association for Sustainable Agriculture (PASA) is also gaining momentum as the major association for farmers interested in sustainable agriculture in Pennsylvania. In addition to the key roles played in sustainable agriculture funded projects, PASA held its second annual conference in February, 1993 with 500 people in attendance. The conference was sponsored by multiple agencies including Penn State's College of Agricultural Sciences Sustainable Agriculture Issue committee. Several faculty members of the Issue committee were invited presenters at the conference and the committee also had a booth at the conference advertising a seminar series sponsored throughout the 1992-93 academic year. Speakers for the seminar series included members from the Rodale Institute as well as Penn State faculty and county extension staff. PASA is actively involved in on-farm demonstrations expanding the 1992 program to include 17 farmers participating this year. The PASA newsletter "PASA PASSAGES" is also expanding its coverage of topics and news in each issue carrying this directly to the farm family members. Crop management associations (CMA) continue to grow in Pennsylvania. In

cooperation with Penn State personnel, CMAs increased 10% in membership and 8% in acreage in 1992, with total member farms at 497. This represents 83,513 acres of Pennsylvania farmland now under integrated management practices. These practices utilize computer record keeping that allows field specific information to generate field, crop, and farm specific reports on crop inputs utilized, soil nutrient levels, field activities accomplished, and the cost of crop production. Currently 52% of all CMA members actively utilize computer record keeping. During 1992 the management practices of 45 CMA farmers with 6000 acres were analyzed. These farmers participated in the Agricultural Stabilization and Conservation Service's Integrated Crop Management Cost-Share Special Practice during 1990-91. The following positive changes in pest and nutrient management practices were documented between 1990 and 1991 as a result of services provided by crop management consultants:

- 1) The number of corn fields sampled increased from 6% to 50% in 1991.
- 2) In 1991, 20 growers reduced total nitrogen available on corn acres by roughly 46 tons and total purchased by roughly 27 tons, saving \$12,000 or \$570 per farm.
- 3) Farmers kept better track of nutrient contributions from manure applications in 1991.
- 4) In 1991, 25% fewer corn following corn acres received corn rootworm insecticides, reducing corn insecticide costs by about \$100 per farm.
- 5) The number of alfalfa fields soil sampled increased from 22% in 1989 to over 60% in 1991.
- 6) In 1991, 6% fewer alfalfa acres had phosphorus in deficit of crop requirements, and 4% fewer acres had potassium in deficit of requirements.

- 7) Field monitoring allowed farmers to respond effectively to increased alfalfa pest pressure in 1991, preventing economic losses. Drought conditions in 1991 caused plants to be more susceptible to pest pressure resulting in increased integrated control measures.
- 8) The expert system decision support computer programs are continuing to expand in adoption with 31 county offices and 86 other copies sold for the Bee Aware program. This represents over 9,750 hives of bees managed with this decision support program. Additionally, 16 copies have been sold to government and university organizations in the U.S. and internationally.
- 9) The Penn State Orchard Consultant program is located in 15 county offices, 43 government, university, and ag businesses, and 52 growers representing 2872 acres of Pennsylvania apple production.
- 10) The PLEX program is currently in 3 county offices together with automated weather stations and 10 copies have been provided to government and universities.
- 11) The MAIZE program has not been officially released, but 10 county offices currently use it.

UTAH

Sustainable agriculture continues to be a critical issue in Utah as well as other intermountain states. Utah's arid-alpine (cold/dry) climate causes unique problems when implementing sustainable agriculture, as currently practiced in much of the country. However, many farmers and ranchers are actively interested in implementing sustainable techniques and are pressing the University for answers to their questions. Hence, this is a critical technology-transfer issue at the present time. Utah's program planning and delivery systems are working well with this issue. Interagency (SCS, ASCS, FmHA, BLM,

USDA, USU etc...) and U.S.U. Campus-wide (all researching departments) Sustainable Agriculture Committees have been organized by the Sustainable Agriculture Extension Specialist. Specialists have also been heavily involved in national and regional sustainable agriculture efforts, including a lead role in the Sustainable Agriculture Network. Innovative "Hypertext" InfoBases have been developed for Sustainable Agriculture Publications that make them easily searched and printed. These InfoBases have been highlighted in recent meetings with Congressional staff and elected officials. These InfoBases are:

1. Rasmussen, V.P., J.T. Belliston, & Wes James (1992). FOLIO InfoBase of the PROJECT SUMMARIES from the USDA Sustainable Agriculture Research & Education Program and the USDA/EPA "ACE" Program. U.S.U. Agricultural Systems Technology & Education Department (COMPUTER PROGRAM RELEASE) April 1992. 1.44mb/3.5" IBM Disk.
2. Rasmussen, V.P., J.T. Belliston & Wes James (1992). FOLIO InfoBase of the Western Regional LISA Cereal-Legume Database. U.S.U. Agricultural Systems Technology & Education Department. (COMPUTER PROGRAM RELEASE), December 1992. 1.44mb/3.5" IBM Disk.
3. Belliston, J.T. and V.P. Rasmussen (1992). Folio InfoBase of the AGRONOMY HANDBOOK. U.S.U Agricultural Systems Technology & Education Department. (COMPUTER PROGRAM RELEASE) December 1992. 1.44mb/3.5" IBM Disk.
4. Rasmussen, V.P., J.T. Belliston, & Wes James (1992). FOLIO InfoBase of the U.S.U. Sustainable Agriculture and Conservation Tillage Fact Sheets. U.S.U. Agricultural Systems Technology & Education Department. (COMPUTER PROGRAM RELEASE) December 1992. 1.44mb/3.5" IBM Disk.

5. Rasmussen, V.P., J.T. Belliston, & Wes James (1991). FOLIO InfoBase of Computer FACT Sheets. U.S.U. Plants, Soils & Biomet. Department. (COMPUTER PROGRAM RELEASE) October 1991. 1.44mb/3.5" IBM Disk.
6. Rasmussen, V.P., J.T. Belliston, & Wes James (1991). FOLIO InfoBase of MSU Fertilizer Questions Handbook. U.S.U. Plants, Soils & Biomethology Department. (COMPUTER PROGRAM RELEASE) October 1991. 1.44mb/3.5" IBM Disk.
7. Rasmussen, V.P., J.T. Belliston, & Wes James (1991). FOLIO InfoBase of Utah Soil Conservation Service's: Field Office Technical Guide. U.S.U. Plants, Soils & Biomethology Department. (COMPUTER PROGRAM RELEASE) October 1991. 1.44mb/3.5" IBM Disk.

Several Sustainable agriculture Videos have been produced and have been shown on several local cable systems. These videos are:

1. Belliston, J.T., Rasmussen, V.P., & Belliston, N., (1992). Sustainable Agriculture--A National and Regional Perspective. Completed as part of EPA-319 Grant Fulfillment. (12 minutes). U.S.U. Agricultural Systems Technology & Education Department. Logan, UT. (VIDEO RELEASE) July 1992. 1/2" VHS, SVHS, and 8mm. "Hi-8" Formats.
2. Belliston, J.T., Rasmussen, V.P., and Belliston, N., (1992). SOIL SAMPLING. Completed as part of Utah State Department of Agriculture and EPA-319 Grant Fulfillment (9 minutes). U.S.U. Agricultural Systems Technology & Education Department. Logan, UT. (VIDEO RELEASE) July 1992. 1/2" VHS, SVHS, and 8mm. "Hi-8" Formats.
3. Belliston, J.T., Rasmussen, V.P., & Belliston, N., 1992. Sustainable Agriculture--A UTAH Perspective. Completed as part of Utah State Department of Environmental Quality

Sustainable Agriculture Grant Fulfillment (18.9 minutes).

U.S.U. Agricultural Systems Technology & Education

Department. Logan, UT. (VIDEO RELEASE) December 1992.

1/2" VHS, SVHS, and 8mm. "Hi-8" Formats.

APPENDIX C: ADMINISTRATORS AND LAND GRANT INSTITUTIONS IN THE
SOUTHERN REGION OF THE UNITED STATES

Dr. Gaines Smith, Auburn University

Dr. Chinella G. Henderson, Alabama A&M University

Dr. Velma L. Blackwell, Tuskegee University

Dr. Milo J. Shult, University of Arkansas, Little Rock

Dr. Mazo Price, University of Arkansas, Pine Bluff

Dr. John T. Woeste, University of Florida

Dr. Lawrence Carter, Florida A&M University

Dr. C. Wayne Jordan, University of Georgia

Dr. Fred Harrison, Jr., Ft. Valley State College

Dr. C. Oran Little, University of Kentucky

Dr. Harold R. Benson, Kentucky State University

Dr. Bruce Flint, Louisiana State University

Dr. Leodrey Williams, Southern University and A&M College

Dr. Hiram D. Palmertree, Mississippi State University

Dr. Leroy Davis, Alcorn State University

Dr. Robert C. Wells, North Carolina State University

Dr. Daniel D. Godfrey, North Carolina A&T State University

Dr. Charles B. Browning, Oklahoma State University

Dr. Ocleris Simpson, Langston University

Dr. Byron K. Webb, Clemson University

Dr. Oscar P. Butler, Jr., South Carolina State College

Dr. Billy G. Hicks, University of Tennessee

Mr. Richard Winston, Tennessee State University

Mr. Zerle L. Carpenter, Texas A&M University

Mr. Hoover Carden, Prairie View A&M University

Dr. William A. Allen, Virginia Polytechnic Institute and State
University

Dr. Lorenza W. Lyons, Virginia State University

APPENDIX D: INTRODUCTORY LETTER TO ADMINISTRATORS
OF LAND GRANT INSTITUTIONS

Name
Title
Address

SUSTAINABLE AGRICULTURE STUDY

Dear:

As an administrator of a land grant institution of higher education, you are being contacted to assist with a study that is presently underway. This study will investigate sustainable agriculture capabilities of the Cooperative Extension Service in the Southeast and targets the twenty-seven Cooperative Extension agencies located in the thirteen southeastern states of the United States.

This study will also investigate sustainable agriculture competencies of agricultural agents of the Cooperative Extension Service employed in the southeastern United States, their agricultural and educational background, and their perceptions of sustainable agriculture and selected factors which will effect the future of sustainable agriculture.

The results of this study should provide data that will assist the Cooperative Extension Service in planning future training for agricultural agents in the area of sustainable agriculture.

You are being asked to take a few minutes of your valuable time to assist with this important study by providing a current mailing list of those agricultural agents employed by your land grant institution's Cooperative Extension Service.

Statistical sampling strategies will be utilized to determine which of these agents are contacted to take part in the study. Of those selected, each will receive a survey instrument and will be requested to complete and return it as soon as possible.

Non-respondents will be contacted after a short period and new copies forwarded again to them. Final steps include telephone contact with non-respondents, data compilation, and analysis. You may receive resulting information on participants from your organization if you so desire.

Please forward a list of agricultural agents, their addresses and telephone numbers to me at your earliest convenience. You may FAX it to me at 504-838-1175 if you wish.

I have also enclosed a short statement of support for the completion of this study which you may sign if you desire and return to me. A copy of this letter of support will be included with the questionnaire which will be sent to participants from your organization. I will be in touch with you during the next week to discuss this study further, or you may want to contact me earlier at (504) 838-1170.

Your assistance is very much appreciated. If you would like to receive a copy of the results of this study after it is completed, please write me a note on the personnel list.

Sincerely,

Jerry Sisk

APPENDIX E: STATEMENT OF SUPPORT

This is written in support of the enclosed study. I feel that this study will provide beneficial information with regard to possible training needs of the Cooperative Extension Service. I encourage you to complete the questionnaire as soon as possible and return it, as directed, to the researcher.

Thanks for your attention to this matter,

(signed by state extension director)

APPENDIX F: VALIDATION PANEL

Jim Biles, Oklahoma State University Extension Service, Tulsa, Oklahoma, County Agricultural Agent.

Dr. Mike Cannon, Louisiana Cooperative Extension Service, Baton Rouge, Louisiana, Program Specialist (vegetables and organic gardening).

Gerald Geisler, Louisiana Cooperative Extension Service, Baton Rouge, Louisiana, Program Specialist (farm management and sustainable agriculture).

Peter Grande, Louisiana Department of Agriculture and Forestry, Baton Rouge, Louisiana.

Dr. Jack R. Harlan, Tulane University, New Orleans, Louisiana, Plant Geneticist (grassland breeding, forage crops, rangeland improvement, and crop evolution).

Megan Hughes, Meadowcreek Foundation, Fox, Arkansas, Horticultural Program Director.

Dr. William Lockeretz, School of Nutrition, Tufts University, Medford, Massachusetts.

Basil Myers, Oklahoma State University Extension Service, Muskogee, Oklahoma, County Agricultural Agent.

Dr. Lydia Ori, Louisiana Cooperative Extension Service, Baton Rouge, Louisiana, Program Specialist (solid waste).

Dr. Neill Schaller, Henry A. Wallace Institute for Alternative Agriculture, Greenbelt, Maryland.

Dr. E.N. Escobar, Langston University Cooperative Extension Service, Langston, Oklahoma, Program Specialist (goats).

APPENDIX G: LETTER TO VALIDATION PANEL

November 5, 1994

Name
Title
Address

Dear:

I'm writing to request your assistance with a study in the area of sustainable agriculture that is presently underway. This study will investigate the perceptions of agricultural agents competencies and the capabilities of the Cooperative Extension Service in the Southern region of the United states. Respondents in this study are also being asked to identify their perceptions of sustainable agriculture, and the future of sustainable agriculture. The study which is descriptive in nature, compares respondents by age, agricultural background and current agricultural responsibilities, as well as by state and type of land grant institution.

You, as an agricultural leader, are being asked to assist with this very important study, by validating the survey instrument. A few minutes of your time will mean a great deal towards the completion of the study and to the compilation of new and important data that may be used to improve the delivery of future Cooperative Extension sustainable agriculture topics.

Enclosed you will find a copy of the survey instrument and the specific objectives of the study. We ask that you first study the objectives and then take a few minutes to go over the survey instrument objectively. Indicate whether or not this document addresses and accomplishes the objectives of the study as written. Please place your comments and suggestions for changes and/or improvements following each section and also at the end of the document.

A quick mailing of the contents in the self addressed stamped envelope will assure a prompt and orderly return, and will assist in the finalization prior to forwarding this to the target audience.

Please be assured that your assistance is very much appreciated. If you would like to receive a copy of the abstracted results of this study, please so indicate on the return envelope before mailing.

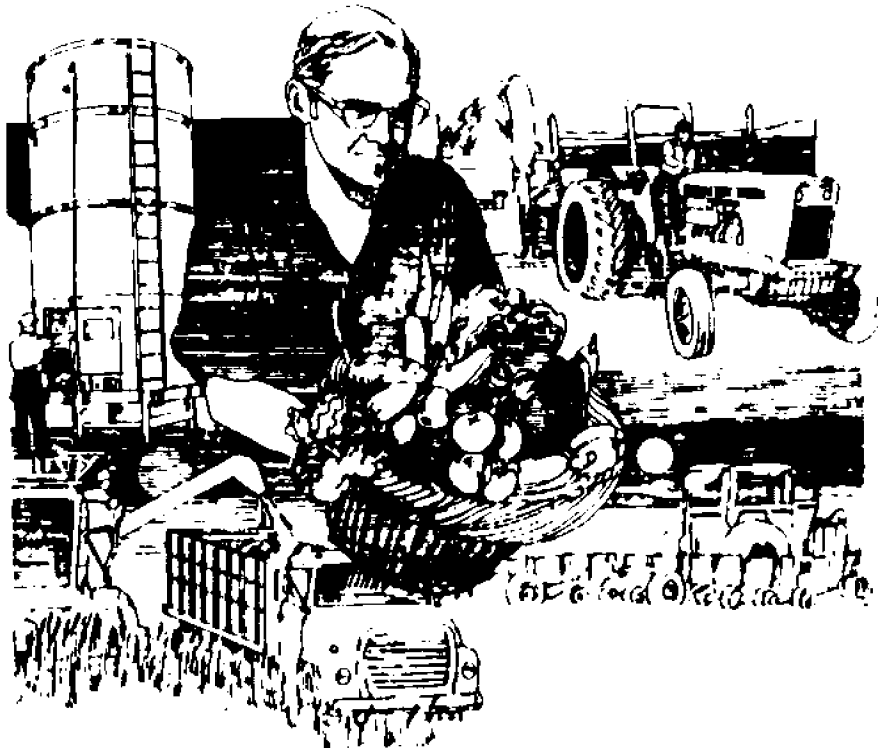
A sincere thanks for your assistance with this project.

Jerry Sisk

APPENDIX H: QUESTIONNAIRE

"Sustainable Agriculture"

"Sustainable Agriculture" is an integrated system of site specific plant and animal production practices. This system satisfies the long term human food and fiber needs and enhances environmental quality. It enhances the natural resource base upon which the agricultural economy depends and makes the most efficient use of nonrenewable and on-farm resources. It integrates natural biological cycles and controls and sustains the economic viability of farm operations. Finally, it enhances the quality of life for farmers and society as a whole. (Adapted from 1990 Food, Agriculture, Conservation, & Trade Act)



PLEASE CONTINUE ON NEXT PAGE

SECTION I. This section addresses perceptions of sustainable agriculture concepts. Please indicate your level of agreement or disagreement with the following statements regarding sustainable agriculture in your state. CIRCLE THE NUMBER THAT REPRESENTS YOUR RESPONSE.

SUSTAINABLE AGRICULTURE CONCEPTS	Slightly No Slightly				
	Disagree	disagree	opinion	agree	Agree
a) Most sustainable agriculture practices can be successfully used in production systems.	1	2	3	4	5
b) A sustainable production system using crop rotation, green manure crops, and animal manures can be economically comparable to a conventional system that uses synthetic fertilizers.	1	2	3	4	5
c) Chemical residues on many fruits and vegetables that are currently available in the marketplace pose a significant health threat to the consumer.	1	2	3	4	5
d) Major outbreaks of insects can be controlled without the use of chemical insecticides.	1	2	3	4	5
e) Most crop disease organisms can be successfully controlled without the use of fungicides.	1	2	3	4	5
f) Weed control in most cropping systems can be accomplished economically without the use of herbicides.	1	2	3	4	5
g) Federal guidelines for acceptable levels of pesticides and other polluting agents found in municipal drinking water systems should be relaxed.	1	2	3	4	5
h) Perennial grain crops, with the potential for sustaining or increasing production with limited inputs, should receive more research emphasis.	1	2	3	4	5
i) The use of organic pest control methods would greatly reduce pesticides and contribute to the reduction of non-point source pollution.	1	2	3	4	5
j) Many sustainable agriculture practices that may be successfully adopted in other states are not economically feasible in this state.	1	2	3	4	5

PLEASE CONTINUE ON NEXT PAGE

SECTION II. This section deals with the sustainability of production agriculture. What impact will each of the following have on the sustainability of production agriculture during the next ten years? CIRCLE THE NUMBER THAT REPRESENTS YOUR RESPONSE.

IMPACT ON <u>SUSTAINABILITY</u> OF AGRICULTURE		Major negative impact	Negative impact	No impact	Positive impact	Major positive impact
a)	Increased nitrate levels in drinking and in irrigation water	1	2	3	4	5
b)	Increased pesticide residues in groundwater	1	2	3	4	5
c)	Modification of Federal farm commodity support systems toward a more ecological base	1	2	3	4	5
d)	Significant shortage of synthetic fertilizers	1	2	3	4	5
e)	The Cooperative Extension Service	1	2	3	4	5
f)	Minimum tillage systems	1	2	3	4	5
g)	Loss of productive lands to population expansion	1	2	3	4	5
h)	Reduced water availability	1	2	3	4	5
i)	Global warming	1	2	3	4	5
j)	Salinization of water	1	2	3	4	5
k)	Severe erosion of major crop land	1	2	3	4	5
l)	Increased utilization of marginal soils that are highly susceptible to erosion	1	2	3	4	5

PLEASE CONTINUE ON NEXT PAGE

SECTION III. This section deals with your perceptions of trends related to the future of sustainable agriculture in the next ten years. Please indicate your level of agreement with the following statements. **CIRCLE THE NUMBER THAT REPRESENTS YOUR RESPONSE.**

TRENDS IN SUSTAINABLE AGRICULTURE		Disagree	Slightly disagree	No opinion	Slightly agree	Agree
a)	Cultural and biological control methods will replace chemical pest control methods in most major agricultural production systems within ten years	1	2	3	4	5
b)	Large irrigation systems will adopt practices that significantly reduce water usage.	1	2	3	4	5
c)	If large farms change their production methods from using heavy inputs of pesticides and synthetic fertilizers to using low-input sustainable methods, this change will create an inability to produce large enough crop yields to support a growing population.	1	2	3	4	5
d)	Salinization of water will pose a serious threat to the irrigation and drinking water systems within ten years.	1	2	3	4	5
e)	The potential loss of genetic diversity in plant varieties through production systems utilizing hybrid, presents the possibility of future devastation of major crops by insects or diseases.	1	2	3	4	5
f)	There will be a substantial return to dryland farming, in the next ten years.	1	2	3	4	5
g)	There will be a large scale reduction in the use of pesticides and synthetic fertilizers	1	2	3	4	5
h)	Waste products from large animal production systems will continue to create significant environmental problems.	1	2	3	4	5

PLEASE CONTINUE ON NEXT PAGE

SECTION IV: The capabilities of the extension service, including the training extension agents receive, are important factors in the ability of extension to recommend appropriate agricultural practices. Please indicate your level of agreement or disagreement with the following statements concerning the capabilities of the Cooperative Extension service in areas of sustainable agriculture. CIRCLE THE NUMBER THAT REPRESENTS YOUR RESPONSE.

EXTENSION CAPABILITIES		<div> <div>Slightly</div> <div>No</div> <div>Slightly</div> </div> <div>Disagree disagree opinion agree Agree</div>				
a)	The Cooperative Extension Service provides the major leadership in areas of sustainable agriculture technology in my county/parish.	1	2	3	4	5
b)	The Cooperative Extension Service has provided adequate training for agricultural agents in areas of sustainable agriculture technology. . .	1	2	3	4	5
c)	More time and adequate funding should be set aside for training in the area of sustainable agriculture.	1	2	3	4	5
d)	The Cooperative Extension Service can provide the continuing needed sustainable agriculture teaching services with present capabilities. . .	1	2	3	4	5
e)	Changes are needed in the qualifications required for newly hired agricultural extension agents to include sustainable agriculture training or competence.	1	2	3	4	5
f)	Personnel presently assigned to sustainable agriculture program areas have the needed expertise to teach specific agricultural concepts utilizing sustainable production methods.	1	2	3	4	5
g)	All agricultural production methods that are being taught and promoted by the Cooperative Extension Service are conducive to the sustainability of agricultural production.	1	2	3	4	5

PLEASE CONTINUE ON NEXT PAGE

SECTION V This section addresses your competencies in selected areas of sustainable agriculture. Competent is defined as capable, fit, or qualified. Indicate your level of competence immediately to the right of each of the sustainable agriculture practices listed on the next page. Then indicate all sources of training you have received in each area in the column to the far right of the statement.

COMPETENCY LEVEL:	TRAINING RECEIVED:
1) Not competent	1) None received
2) Slightly competent	2) University/college course
3) Moderately competent	3) University/college workshop
4) Competent	4) Industry workshop
	5) Professional conference
	6) Self directed learning/personal experience
	7) Working with producers using sustainable agriculture practices
	8) On-the-job/in-service training

NOTE: THE RESPONSE CATEGORIES ABOVE SHOULD BE USED TO ANSWER THE QUESTIONS ON THE NEXT PAGE. DO NOT MAKE ANY MARKS ON THIS PAGE.

PLEASE CONTINUE ON NEXT PAGE

SUSTAINABLE AGRICULTURE COMPETENCIES	COMPETENCY LEVEL				TRAINING RECEIVED							
	Circle Your Choice				Circle <u>All</u> That Apply							
a) Biological pest control methods in sustainable production systems	1	2	3	4	1	2	3	4	5	6	7	8
b) The use of trap crops in sustainable production systems	1	2	3	4	1	2	3	4	5	6	7	8
c) The use of cover crops in sustainable vegetable production systems	1	2	3	4	1	2	3	4	5	6	7	8
d) The use of cover crops in sustainable orchard production systems	1	2	3	4	1	2	3	4	5	6	7	8
e) Minimum Tillage production systems	1	2	3	4	1	2	3	4	5	6	7	8
f) No-Till production systems	1	2	3	4	1	2	3	4	5	6	7	8
g) Ridge tillage production systems	1	2	3	4	1	2	3	4	5	6	7	8
h) Weed management in sustainable agriculture systems	1	2	3	4	1	2	3	4	5	6	7	8
i) Solid waste product utilization in sustainable agriculture systems	1	2	3	4	1	2	3	4	5	6	7	8
j) Soil nutrient management and fertilization methods in sustainable agriculture systems	1	2	3	4	1	2	3	4	5	6	7	8
k) Interplantings, cover crops, and green manure utilization in sustainable agriculture systems	1	2	3	4	1	2	3	4	5	6	7	8
l) Rotational systems in agronomic crops for sustainable agriculture production	1	2	3	4	1	2	3	4	5	6	7	8
m) Rotational livestock grazing systems for sustainable agriculture production	1	2	3	4	1	2	3	4	5	6	7	8
n) The integration of animal and plant systems in sustainable agriculture systems	1	2	3	4	1	2	3	4	5	6	7	8
o) The use of computer software dealing with sustainable agriculture topics	1	2	3	4	1	2	3	4	5	6	7	8

PLEASE CONTINUE ON NEXT PAGE

SECTION VI DEMOGRAPHIC INFORMATION. This section addresses demographic information. PLEASE RESPOND TO EACH QUESTION AS INDICATED.

- a. Describe your farming experience. (Circle the numbers of all that apply to you):
- 1) Worked for pay on a production farm for a total of one year or longer
 - 2) Grew up on a farm and worked on a production farm for parents
 - 3) Never worked on nor lived on a production farm
 - 4) Lived on but did not work on a production farm
 - 5) Operated a production farm
 - 6) If the above do not apply to you, please indicate in the space provided what kind of agricultural experience you had prior to being employed by Cooperative Extension Service.
-
- b. Indicate the agricultural area in which you spend the major amount of your professional extension time? (Please circle the number by the one response that best represents the kind of work that you are presently involved in).
- 1) Rural agronomic crop production
 - 2) Rural horticulture
 - 3) Rural livestock production
 - 4) Rural non-farm
 - 5) Rural vegetable production
 - 6) Rural tree/timber production
 - 7) Urban/suburban agronomic crop production
 - 8) Urban/suburban horticulture
 - 9) Urban/suburban livestock production
 - 10) Urban/suburban non-farm
 - 11) Urban/suburban vegetable production
 - 12) Urban/suburban tree/timber production
 - 13) Other - please indicate: _____

PLEASE CONTINUE ON NEXT PAGE

-
- c. Do you spend the largest segment of your time working with owners/operators of small farms, moderate to large farms, agribusinesses, or other agricultural production? (Circle Your Response)
- 1) Small Farms (Below \$50,000 gross income)
 - 2) Moderate to Large Farms (All other farms)
 3. Agribusinesses
 - 4) Other agricultural production (Please specify: _____)
- d. What is your age? _____ Years (write answer in blank)
- e. How many years have you been employed by the Cooperative Extension Service?
- _____ Years (write answer in blank)
- f. Please indicate your highest level of educational attainment? (Circle the number)
- 1) Bachelor's degree
 - 2) Master's degree
 - 3) Doctoral degree
 - 4) Other (please indicate): _____
-

PLEASE CONTINUE ON NEXT PAGE

g. What was your undergraduate major? (Circle the number beside the correct answer)

- 1) Education (agricultural, extension, adult, etc.)
- 2) Animal Sciences (poultry science, dairy science, veterinary science, etc.)
- 3) Plant Sciences (agronomy, horticulture, floriculture, forestry, etc.)
- 4) Agricultural Business and/or Economics
- 5) Wildlife/Fisheries (does not include forestry)
- 6) Environmental Sciences
- 7) Other: (Please write the name of your degree here:_____)

h. If you have completed your Master's degree, what was your major field of study? (Circle the number beside the correct answer)

- 1) Education (agricultural, extension, adult, etc.)
- 2) Animal Sciences (poultry science, dairy science, veterinary science, etc.)
- 3) Plant Sciences (agronomy, horticulture, floriculture, forestry, etc.)
- 4) Agricultural Business and/or Economics
- 5) Wildlife/Fisheries (does not include forestry)
- 6) Environmental Sciences
- 7) Other: (Please write the name of your degree here:_____)

THANK YOU FOR YOUR ASSISTANCE IN COMPLETING THIS QUESTIONNAIRE. WE APPRECIATE YOU TAKING THE TIME TO ASSIST IN THIS SUSTAINABLE AGRICULTURE PROJECT. YOUR RESPONSES WILL BE HELD IN STRICT CONFIDENCE.

RETURN TO:

JERRY SISK/DR. JOE KOTRLIK
SCHOOL OF VOCATIONAL
EDUCATION
ROOM 129 OLD FORESTRY
BUILDING
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LA 70803-5477



APPENDIX I: FIRST COVER LETTER TO PROGRAM PARTICIPANTS

January 17, 1995

Dear first name-:

You are being asked to take part in a "Sustainable Agriculture" study. This research study, is the first of its kind, and involves the Cooperative Extension Service in the Southern Region of the United States. No other agencies, private organizations, or self-interest groups are involved in this study. The study will involve a very small sample of Extension agricultural agents from thirteen Southern states.

You have been chosen to represent your fellow agricultural agents employed by the Cooperative Extension Service in the state of state~, and are only one of number~ agents in your organization asked to complete the enclosed survey instrument.

This study will provide beneficial information for Extension training that is being planned for this year. It will also provide the opportunity for you to express your perceptions about sustainable agriculture.

It is imperative that your input be received, because of the size~ population of your states' Cooperative Extension agriculture agents.

Your quick response will help to assure that training decisions are made based on the most current information. Please complete the enclosed questionnaire immediately, place in the envelope provided, and return no later than date~.

NO! NO! DON'T LAY IT DOWN ON YOUR DESK! PLEASE COMPLETE IT RIGHT NOW! WE'RE WAITING ON YOUR RESPONSE!

THANKS VERY MUCH FOR YOUR HELP,

Jerry Sisk
Project director

c administrator~

APPENDIX J: SECOND COVER LETTER TO PROGRAM PARTICIPANTS

February 7, 1995

Dear first name-:

Recently I mailed a letter to you requesting your assistance with a "Sustainable Agriculture" study. This research study, which is partially completed, involves a small sample of Extension agricultural agents from thirteen Southern states.

You have been asked to represent your fellow agricultural agents employed by the Cooperative Extension Service in the state of state-, and are one of only number- agents in your organization from whom we have not yet received the survey instrument that was mailed to you on January 18, 1995.

The purpose of this study is to provide beneficial information for Extension training presently being planned for later this year. It also provides you the opportunity for expression of your perceptions about sustainable agriculture.

It is very important that we receive your input, because of the size- population of your states' Cooperative Extension agriculture agents. We realize that you may have been too busy to complete this questionnaire, or that you may have possibly overlooked or misplaced it. Again I am asking..... Please complete the questionnaire, place in the envelope provided, and return to me by date-.

If you have already returned the questionnaire, please disregard this letter.

Your help is very much appreciated

Jerry Sisk
Project director

c administrator-

APPENDIX K: RESPONSE RATE BY UNIVERSITY

Table K-1

Response Rate by University

Type Institution	Target audience	Sample size	Usable response	Response %
<u>1862 Land Grant Institutions</u>				
Auburn University	136	20	20	100.00
University of Arkansas Little Rock	123	20	20	100.00
University of Florida	130	26	25	96.15
University of Georgia	227	38	38	100.00
University of Kentucky	123	31	31	100.00
Louisiana State	84	16	15	93.75
Mississippi State	54	8	7	87.50
N. Carolina State	183	38	38	100.00
Oklahoma State	72	16	16	100.00
Clemson University	102	19	16	84.21
University of Tennessee	136	24	24	100.00
Texas A&M University	345	61	55	90.16
Va. Polytechnic Institute and State University	133	18	16	88.88

(table continues)

Type Institution	Target audience	Sample size	Usable response	Response %
<u>1890 Land Grant Institutions</u>				
Alabama A&M University	6	6	4	66.66
Alcorn State University	2	2	2	100.00
Florida A&M University	15	15	13	86.66
Fort Valley State	7	7	7	100.00
Kentucky State	4	4	4	100.00
N. Carolina A&T St.	6	6	6	100.00
Prairie View A&M	8	8	8	100.00
S. Carolina St. College	3	3	3	100.00
Southern University	7	7	7	100.00
Tennessee St. University	3	3	3	100.00
Tuskegee University	6	6	6	100.00
Total	1915	402	384	95.52

Note. Of the 412 agents in the original sample, ten were determined to be frame errors because they had retired or resigned prior to the completion of the study, which resulted in a final sample size of 402.

VITA

Jerry Gene Sisk was born in Fort Worth, Texas. He is the son of Mr. William Orna Sisk (deceased) and Mrs. Ora Lea Willbern Sisk and is one of three children. A brother, James Keith Sisk, lives in Hammond, Louisiana, and a sister, Gloria Ann Sisk Holm lives in Greely, Colorado.

Jerry Sisk served four years in the United States Marines from 1959 to 1963, and received an Honorable Discharge. From 1963 to 1977, he was employed in the private business sector. He was employed by the Louisiana Cooperative Extension Service in 1977 and went to work in Crowley, Louisiana, as a 4-H agent in Acadia Parish. He left there in 1979 to work for the Oklahoma State University (OSU) Extension Service in Muskogee, Oklahoma as an agricultural agent in Muskogee County. He later worked in Eufaula, Oklahoma as an agricultural agent in McIntosh County, and then in Wagoner, Oklahoma, as the OSU County Extension Director in Wagoner County. He returned to work with the Louisiana Cooperative Extension Service in Louisiana in 1984 as 4-H agent in St. Tammany Parish. He was employed there until moving to Jefferson Parish in 1990 where he is currently employed in Metairie, Louisiana, as an agricultural agent.

Jerry is married to Judith Ann Johnson Sisk and lives in Kenner, Louisiana. They have four children, and three grandchildren.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Jerry G. Sisk

Major Field: Vocational Education

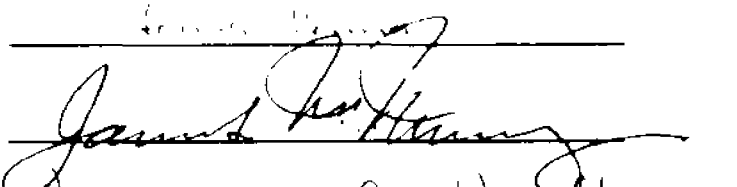



Title of Dissertation: Extension Agricultural Agents' Perceptions
of Sustainable Agriculture in the Southern
Region of the United States

Approved:


Major Professor and Chairman


Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination:

June 30, 1995